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CHARLES W. PRICE
PRESIDENT AND TREASURER
STEPHEN H. GODDARD
SECRETARY
CHARLES T. CHILD
TECHNICAL EDITOR
RUSSELL HOWLAND
GENERAL REPRESENTATIVE

WESTERN OFFICE
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THE INSTITUTE CONVENTION.

The summer meeting of the American Institute of Electrical Engineers, of late called the annual convention, has just closed at Buffalo after a session of ten days which begun at New York and ended at the Pan-American Exposition. The meeting was one of the best, both in point of interest and in interesting programme, that has marked the history of the Institute. But there has been a feeling throughout the long session that under other circumstances and in another place the meeting would have been better worth attending and of greater value.

The truth that an exposition is not a proper place for the holding of meetings at which serious work has to be done is becoming more and more apparent to numerous societies and associations which have, of late years, been dragooned into attending fairs and being made a feature of exhibitions. Aside from any other consideration, the meetings become a sort of appendage of the exposition and lose the individuality and dignity that should mark them when the body in session is of the importance of the American Institute of Electrical Engineers, for example. And beside this is the noise, the confusion, the extortion and the discomfort of exposition cities and exposition conditions.

In this year's meeting of the Institute all these features were prominent. There were no arrangements whatever made for the comfort, entertainment or reception of the visiting body, and, beyond the privilege of a hall of incredibly bad acoustic properties at the exposition. grounds, no arrangements of any kind made for its convenience. And, seeing that the members and guests had to pay their way in at the gates to attend their own meetings, this was no great concession. To speak the plain truth, the meeting which should have been an event to command the interest and enlist the most hospitable efforts of any community honored by its selection, was lost in the seething spectacle of the Rainbow City. No official recognition was extended by either the exposition or the municipal authorities to the Institute, whose members have made the exposition possible, have made Niagara a city and Buffalo an industrial miracle.

But, as M. Janet, the accomplished delegate of the sister society of France, pointed out in his remarks on another subject, the harder the experience the more valuable the lesson. It is to be hoped that the Institute will never again meet at an exposition or in an inland city in the summer. The general concensus of its members is that it never will.

Each year, with expanding membership and growing influence, the reunion of the Institute is becoming a more important and valuable occasion. Each succeeding meeting is better attended than the last, and each is more productive of general benefit. This year, although only one paper was a distinctly valuable contribution to knowledge, the actual engineering data produced and the vitality of the discussions were greater than ever before. In spite of the place and surroundings of the meeting it was a distinct success.

POWER TRANSMISSION AND INDUSTRY.

More and more, as the labor of machines is substituted for that of men and beasts in our industrial operations, the question of power and its sources becomes important. In the old days of handicrafts, when every workman was his own power station, it made little difference where work went so far as its productive capacity was concerned, and only the larger questions of facility for exchange and shipment, aided by the natural gregarious tendency of the race, had worked for the foundation and growth of cities.

But with the increasing industrial importance of power a new factor in the distribution of population was added, and around the coal mine or the waterfall, as well as at the port and the cross-roads, there grew up settlements for the utilization of the natural power-producing agencies in manufactures. For example, when the advancing tide of white immigration first drove the aboriginal inhabitants of this country back from the coast, the most ill-favored section naturally was that lying to the east and north of the Connecticut River, yet not more than two hundred years passed before this very region was at once the most populous and the richest of the long stretch of the Atlantic coast, and this simply on account of the configuration of its hills and coast, which made the rivers flow swiftly and over waterfalls and rapids, rather than sluggishly, toward the sea.

The waterfalls of the Connecticut, the Merrimac and other rivers, became the centres around which grew up thrifty towns and villages, while the seaboard of the middle and southern states was given over to agriculture, and, by comparison, was sparsely populated.

Electric power transmission has enabled the bringing of power from otherwise badly situated waterfalls to points where it can be utilized to advantage, and also the distribution of the power to long dis-

tances surrounding the points at which it is produced. The consequence is that the manufacturing area has been greatly extended, potentially, at least, by this application of electricity, and an entirely new set of conditions has been formed which is of great interest.

In the southern Atlantic states, for example, there are magnificent waterfalls on the eastern slopes of the mountains, but these, in a country not well provided with railroads, are so situated as to be of little avail provided manufacturing has to go to their sites. The consequence has been that electric transmission has afforded an outlet for this power which has been eagerly seized for manufacturing purposes. In the last ten years the entire industrial status of Georgia and South Carolina has been changed by the rapid extension of manufacturing industries in those states, due almost wholly to the utilization of water powers and very largely to electrical transmission.

The most interesting and elaborate engineering works for power transmission have been undertaken in California and in the other states of the Pacific slope, where the coast cities are situated at a considerable distance from the mountains wherein the waterfalls are situated. The climate of that region is ideal for power transmission purposes, being very dry. The highest voltages in commercial use have been put to work for transmissions up to distances of nearly two hundred miles, and this power has already wrought an industrial miracle in the regions in which it has been introduced. Coal is expensive and scarce on the Pacific coast, and a ready market was found for all the electrical power that could be developed, with the effect that countless industries have sprung up where none existed before, and have vitally affected for the better the productive capacity and general wealth of the Pacific states. These are only a few of the instances that might be cited where the beginnings of the great industrial revolution that is to be wrought by electric power transmission may be traced. What the ultimate result will be when power may be distributed to any point where it is most desirable can hardly be foreseen. It must, however, result in the scattering of some centres of population which are now dependent on natural conditions, such as coal mines, and the upbuilding of others, or rather of districts in which manufactures will go on over widely extended areas rather than in the contracted limits of a factory town.

GAS ENGINES FOR STATION DRIVING.

Shortly after the general distribution of illuminating gas in cities had become common, it was noticed that a mixture of this gas and air was explosive. Attempting to utilize the force of explosions of this mixture in a cylinder of an engine, M. Lenoir made two very interesting discoveries; one was that such an engine was entirely practical for everyday use, and the other was that the conversion of the chemical energy of combination of the fuel and the oxygen of the air was far more efficient by the use of this engine than if the gas had been burned to boil water and supply steam.

The development of the gas engine went on with great rapidity. Until very recent years these machines were confined to small sizes and were used to a limited extent only. This was largely due to the expense of burning city gas, enriched for illuminating purposes with costly ingredients and transmitted, often with tremendous loss, for some distance through buried pipes. It was cheaper, in other words, to use a small steam engine than to buy gas at the prevailing rates for the article supplied in cities as an illuminant.

The extraordinary efficiency of the gas engine, however, and the very evident possibilities of this type of prime motor did not permit interest in it to wane. New processes for making gas were discovered and natural gas was found in very large quantities in various parts of the world. The consequence was the beginning of experiments for the design of gas engines of large power to replace steam engines of considerable size for stationary work.

It was found that gases too poor to burn when they were cold made excellent fuel when issuing hot from the converter or producer into the cylinder of the engine. In Belgium exceedingly satisfactory experiments have been made with the burning of blast furnace refuse gases in engines as large as 1,000 horse-power. In this country three-cylinder gas engines up to 1,000 and 1,500 horse-power are operating with entire satisfaction on natural gas and have proven to be easily regulated and exceedingly satisfactory as prime motors for electric generating apparatus.

An immediate economy is secured in the gas engine, not only by its great efficiency as compared with the steam engine, but by the fact that it requires no boiler, needs much less floor space than a steam engine, and requires little attention while running. As yet the art of gas-engine building may be said to be in the formative stage only, and much experimental work will have to be done before the same perfection of result that is attained with the steam engine can be secured; but the astonishing economy in fuel resulting from burning coal first in the gas-making producer and then using the gas in a gas engine invites experiment, and, no doubt, will finally result in a great perfection of this new type of prime moving apparatus. The progress of gas-engine design and construction should not be lost sight of by station managers and others interested in securing a motive power for the least cost. The perfection of these machines has been accelerating with remarkable rapidity and to-day a number of thoroughly responsible manufacturers stand ready to guarantee the results which may be obtained from their use.

In anticipation of an early termination of the war in South Africa orders have been placed for steel rails and rolling stock, which will be required on the cessation of hostilities; also for bridge and structural iron and galvanized sheet iron, immense quantities of which will be needed. The rebuilding of the telegraph lines will call for much material; and the various electric installations and sanitary and waterworks, planned or under way, are to be completed. In Cape Colony the railways are well conducted and every year pay a good revenue to the government. Over 40,000 tons of coal, mostly colonial, are consumed monthly. It is believed that American electrical manufacturers are largely interested in this development in South Africa.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XLI.

BY W. ELWELL GOLDSBOROUGH.

Earlier in the discussion of polyphase systems it was pointed out that Fig. 98 does not represent conditions entirely analogous to the commercial working of two-phase systems. Fig. 104, however, illustrates exactly the conditions which three-phase alternate-current working imposes in practice. It will be seen that in spite of the fact that the system is unbalanced, power is developed by the three generators approximately in the proportion that power is absorbed in the circuits with which the generators may be considered as individually associated. In the case of the two-phase system of Fig. 98 this is not true. In other words, the phase diagram that goes with Fig. 104 has not the elements of unstability which are apparent in the phase diagram of Fig. 102 which goes with the two-phase system of Fig. 98. Under ordinary circumstances the conditions that prevail in the individual circuits of a three-phase system are such as admit of the three impressed electro-motive forces being quite nearly in phase with the electro-motive forces apparent at the terminals of the circuits with which the impressed electro-motive forces are associated. In other words, referring directly to Fig. 109, we may say that the point O is seldom so far removed from the point O′ that the angles of phase difference between the line currents (as OB_1) and their electro-motive forces (as $O'A^I$ and OA^I) are materially different.

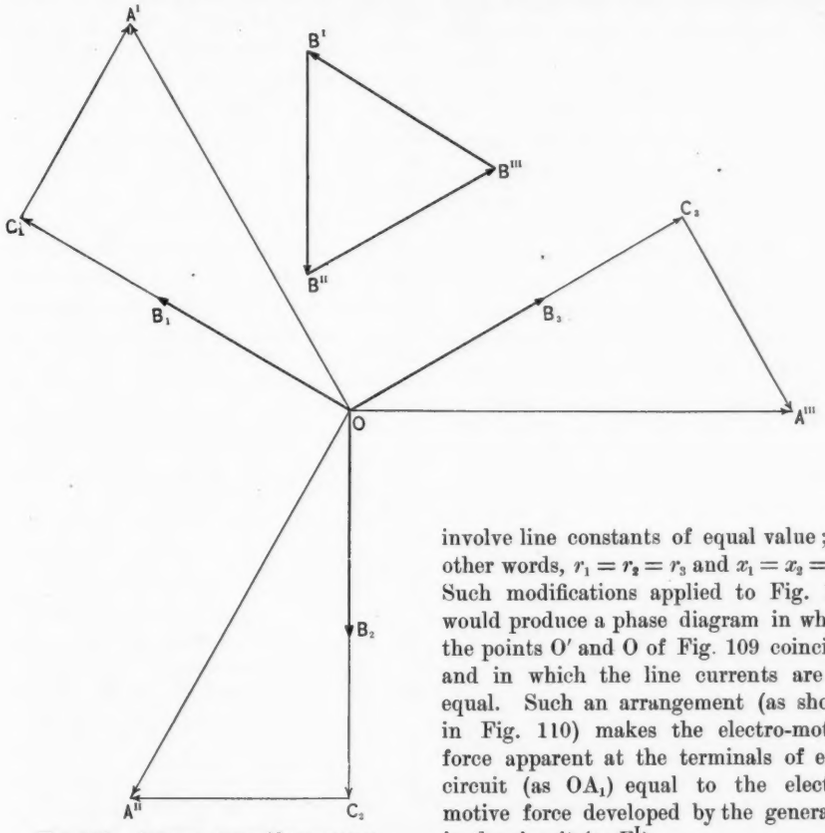


FIG. 110.—ALTERNATING MECHANISMS.

In the case of a balanced three-phase system the conditions presented are exceptionally simple. In the present instance a balanced system would involve the vectors $O'A^I$, $O'A^{II}$ and $O'A^{III}$, all being equal in length. It would further involve line constants of equal value; in other words, $r_1 = r_2 = r_3$ and $x_1 = x_2 = x_3$. Such modifications applied to Fig. 104 would produce a phase diagram in which the points O′ and O of Fig. 109 coincide, and in which the line currents are all equal. Such an arrangement (as shown in Fig. 110) makes the electro-motive force apparent at the terminals of each circuit (as OA_1) equal to the electro-motive force developed by the generator in the circuit (as E^I).

A balanced three-phase system is therefore one in which a generator impressed upon one of the three circuits of the whole system can be said to influence that circuit alone; the generator is then a source from which the energy absorbed in its own circuit is derived, and the source of that energy only. In commercial practice three-phase systems are laid out with the end in view of having them balanced at all times; consequently, the balanced condition is one which can be safely assumed in considering three-phase distributing systems. If, in the treatment of the ordinary three-phase distributing systems, therefore, we follow out the suggestion contained in the above clause we find that the treatment of a three-phase system is very simple, since it involves merely the treatment of each of the circuits of the system as an independent single-phase circuit. For instance, take the case of Fig. 104 considered as a balanced system. In building up a phase diagram to represent all of the forces acting in this system it is only necessary to consider the electro-motive force E^I as acting on the circuit $O'A_1O$ alone. The method of procedure in this case is illustrated by that part of Fig. 110 that is included within the semi-circle OC_1A^I. Here OA^I equals E^I, OC_1 equals I_1r_1 and C_1A^I equals I_1x_1; and, finally, OB_1 equals I_1. The values of these vectors are determined from an application of Equation 54,

$$I_1 = \frac{E^I}{\sqrt{r_1^2 + x_1^2}}$$

from which the numerical value of I_1 is derived.

The vector diagram of Fig. 110 included in the semi-circle OC_2A^{II}, which applies to the circuit $O'A_2O$, and the diagram included in the semi-circle OC_3A^{III}, which applies to the diagram $O'A_3O$, are both identical with the diagram included within the semi-circle OC_1A^I, consequently, the current-vector diagram of this figure, as bounded by the points $B^IB^{II}B^{III}$, is an equilateral triangle.

Example 21.

Given: A distributing system such as that illustrated diagrammatically in Fig. 104. Here the generator E^I develops an electro-motive force of 1,200 volts, the generator E^{II} develops an electro-motive force of 1,100 volts and the generator E^{III} an electro-motive force of 1,000 volts. The three machines are operated synchronously, and their armatures are so secured relatively to one another that there is a constant phase displacement of 120 degrees between the electro-motive forces which they develop. The generators are connected in with three distributing lines so as to form a three-phase star-connected system. The resistance of the line A_1O is 15 ohms, and its reactance is also 15 ohms; the resistance of the line A_2O is 8.3 ohms, and its reactance 16.6 ohms, while the resistance of the line A_3O is 22.4 ohms, and its reactance 11.2 ohms. The machines operate at 60 cycles per second, and the resistance and reactance of their armatures may be neglected.

Determine the values of the currents which are set up in the three lines, the lag of these currents behind the electro-motive forces impressed at the line terminals, the phase position assumed by the three currents relatively to the generator electro-motive forces, and, finally, the values of the electro-motive forces impressed at the terminals of each of the three circuits.

Science Brevities

Metal Niobium—This metal has lately been prepared in the pure state by M. Henri Moissan with the aid of the electric furnace. The properties of this metal have been practically unknown heretofore, the metal not having been prepared in the pure state except by Roscoe, who obtained it as a gray powder. M. Moissan now produces a considerable quantity of the metal in the electric furnace, starting from an American niobite which contains niobic and tantalic acids. An alloy of niobium and tantalum is first obtained by reducing the powdered mineral with carbon in the electric furnace. This alloy is crystalline, of a light, gray color, and contains about two per cent of combined carbon. By a series of reactions the niobium is separated from the alloy in the form of niobic acid, which, after calcination, is a pure white powder. To prepare the niobium, the acid is mixed with powdered carbon and pressed into small cylinders; a number of these are placed in a carbon trough contained in a carbon tube, and the whole placed in the middle of the electric furnace. A few minutes' heating suffices, with a current of 600 amperes and 50 volts. The decomposition is violent, and as soon as the niobic acid becomes fused a lively effervescence takes place. After cooling, a well formed ingot of metallic niobium is obtained, which contains from two to three per cent of combined carbon. The metal has been examined as to its physical and chemical properties. It is quite hard and scratches glass and quartz easily. It is not fused in the oxy-hydrogen flame, and therefore its fusing point is above 1,800 degrees centigrade, but in the electric furnace it liquefies easily. As to its chemical properties, it is found to vary considerably from most of the other metals. It does not decompose water vapor at a red heat, and is almost unattacked by acids. Hydrochloric and nitric acid and aqua regia have no action upon it; hydrofluoric and sulphuric acids attack it but slightly, but it dissolves rapidly in a mixture of hydrofluoric and nitric acids. The gases attack it more readily. Heated in fluorine, it becomes incandescent and gives abundant fumes of a volatile fluoride. Chlorine attacks it at 205 degrees centigrade, with disengagement of heat, producing a volatile chloride, $NbCl_5$ of a golden-yellow color. Bromine vapor forms a light, yellow sublimate, but iodine seems to be without action. The niobium, reduced to powder, and heated in a current of oxygen, takes fire at 400 degrees with brilliant incandescence, forming niobic acid. When the powdered metal is heated in a current of nitrogen to 1,200 degrees, each particle becomes covered with a fine yellow coating of nitride of niobium. The action of carbon is somewhat curious. When the metal is maintained in fusion in the presence of graphite, it slowly absorbes carbon, which enters into combination. Niobium does not readily form alloys with the other metals. Sodium, potassium and magnesium may be distilled over it without combining, and it does not form an alloy with zinc. When heated with soft iron in fusion a small quantity enters into combination with the iron. The alloy shows an irregular structure containing fragments of niobium, a combination of the two metals, or, perhaps, a double carbide, and pure iron in excess. Oxide of chromium is reduced by the metal in the electric furnace, and gives a brittle alloy of chromium and niobium. Fused potash attacks the metal with the formation of an alkaline niobate. Chlorate of potash reacts upon it at a high temperature with brilliant incandescence, and nitrate of potash attacks it with violent disengagement of nitrous fumes. The reactions obtained with niobium seem to place it apart from the other metals and ally it to boron and silicon.

Rœntgen Ray Work—The use of the Rœntgen rays on the body sometimes gives rise to mortification of the skin, according to an article in the *Comptes Rendus*. When the tubes are driven by influence machines it does not happen, but when the activity is reduced, the presence of moisture and the necessity of an earth connection may prove to be inconvenient. The difficulty, however, would appear to have been successfully met by one R. Demerliac, who has found that tubes worked by alternate currents of high frequency and high tension never produce erythema, and that, on the contrary, the rays so obtained possess the curative properties recognized in electrotherapeutics since the experiments of d'Arsonval, Oudin, Dourner and others. He therefore employs the Oudin resonator, which, with certain precautions, may be made to work X-ray tubes. They light upon connecting them with the upper knob of the apparatus. A broad, concave cathode and a small anode or an annular anode are used. The cathode is joined to the resonator, and the anode may be left free or put to earth. The discharge is most effective when it proceeds in one direction only. A cathode valve should, indeed, be useful. The tubes may be brought quite close to the skin without risk, and thus any loss of penetrative power is effectually counteracted.

Osmium Filaments—A method of making incandescent lamp filaments of osmium has been found by M. Auer von Welsbach. The lamp presents many new features. The incandescent lamp is more economical the higher the temperature at which the filament burns, and as osmium is the metal which has the highest fusing point, it is found that it can be burned at a higher temperature than the carbon filament, with consequent economy of energy. Although osmium has usually been recognized as a pulverulent or spongy body, but yet, in its hard form the inventor has succeeded in making filaments of it, and the new lamp is receiving considerable attention. It is said to give more light for a given consumption of energy, and its life is said to be greater than that of the carbon filament; the osmium lamp takes 1.5 watts per candle-power and lasts 600 hours, even reaching as high as 1,000 to 1,200 hours. When the bulb has become darkened on account of the deposit, it may be cleaned easily and cheaply without having to change the filament or bulb. On account of the lower electrical resistance of the osmium filament the lamps are burned at a lower voltage than for carbon filaments; they are at present for tensions of 20 to 50 volts. On an alternating-current system this voltage is easily obtained by the use of the proper transformers. Another advantage of this low voltage is found in its use with accumulators, as a less number of cells are rerequired; on account of the diminished weight the system promises to be valuable for vehicle and railroad lighting. According to the experiments carried out by M. Scholz, the lamp has an economy of 60 per cent over the present lamp. It is said that the lamp is already being made in capacities from 5 to 200 candle-power.

Wood Made Fireproof by Electricity—Wood is made fireproof by the Noden and Bretonneau process, as used at Paris, by placing it in a bath of magnesium sulphate. Lead electrodes are used, the one being separated from the other by a sail-cloth diaphragm. A direct current of 110 volts is then sent through the wood, with the result that the sap is extracted and is replaced by a non-inflammable salt. The phenomenon is thus explained: 1. Part of the sulphate fills up the cells by electro-capillarity. 2. There is an osmotic exchange between the sulphate and the salts of the sap. Aseptic action. The process has been applied with success to paving blocks. The treatment lasts for 48 hours, the timber being turned over after 24 hours. The rate of energy is about half an electric horse-power at 20 to 30 volts per cubic metre.

DEVELOPMENT OF THE NERNST LAMP IN AMERICA.*

BY ALEXANDER JAY WURTS.

It was in 1897 that Mr. Henry Noel Potter, while in the employ of Mr. Westinghouse, at Goettingen, became acquainted with the Nernst lamp. Early in 1898, Dr. Nernst, Mr. Potter and an assistant came to East Pittsburgh, at Mr. Westinghouse's request, and exhibited the new discovery. Mr. Westinghouse quickly recognized its great possibilities and directed the writer to prepare for its commercial introduction. A happy choice brought Mr. Marshall W. Hanks to my assistance. Mr. Potter returned to Goettingen to study some of the details of the work. In June, 1899, Mr. Edward Bennett joined us, as did also Mr. Frederick M. Goddard a month or two later, who had been assisting Mr. Potter in Germany; but, unfortunately, in December of that year, Mr. Goddard contracted a violent cold, from which he never recovered. In February, 1900, Mr. Murray Charles Beebe joined us, and, in August of the same year, Dr. Max von Recklinghausen.

I have thus briefly introduced the characters who have worked upon the Nernst lamp in America, and without whose names its history would be incomplete; my only regret being that these gentlemen are not all present on this occasion to share in the pleasure of announcing to the American Institute of Electrical Engineers the results of our work upon the Nernst lamp.

THE GLOWER.

It is not my purpose to describe the details of our experiments, but rather to give the results of our work. Let us begin with the glower, so named to distinguish from the filament of the incandescent lamp.

Our standard 220-volt glower is about 25 millimetres long and 0.63 of a millimetre in diameter. It is made by expressing from a die a dough made of the rare earths mixed with a suitable binding material, cutting the porcelain-like string thus made into convenient lengths, drying, roasting and finally attaching lead wires. This sounds very simple, but the making of glowers is an art not easily acquired; it is the result of long and painstaking investigation, particularly with reference to the terminal connection between the glower and the lead wire. This connection, as Dr. Nernst made it, consisted of a few turns of platinum wire wound around each end of the glower, the convolutions being finally pasted with cement. This forms a successful and effective terminal, but the shrinkage of the glower ends, away from the convolutions of platinum wire, sometimes causes the contact to deteriorate, resulting in the weakening and early destruction of the glower near the terminal. In the Hanks terminal these conditions are reversed. A platinum bead is embedded in the end of the glower in such a manner that any tendency to shrink on the part of the glower material can result only in tightening the contact and thereby maintaining intimate union between the platinum bead and the glower. It is, then, a simple matter to fuse lead wires to the embedded platinum beads.

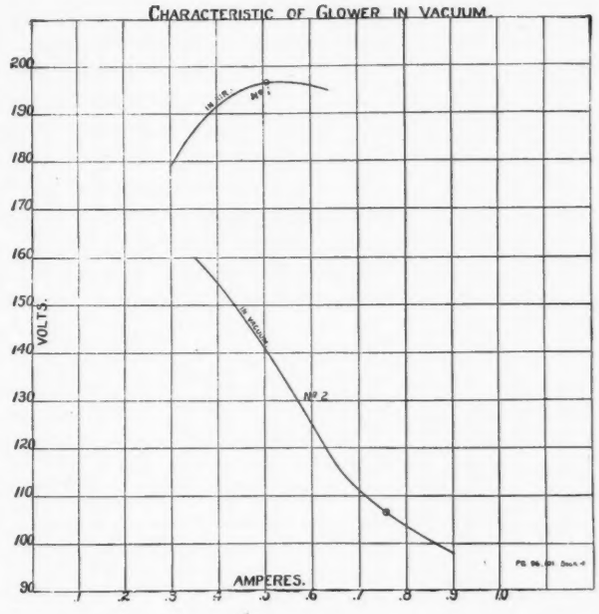


FIG. 1.

The glower, as you know, is a non-conductor when cold, becoming, however, a conductor when heated. It is also an electrolyte; but it may be fairly stated that this phenomenon is not clearly, if at all, understood. Oxygen, however, seems to be necessary, or at least desirable, for its successful operation. As might be expected, no electrolytic action is apparent when operating with alternate current. With direct current, the electrolytic action is quite marked, resulting in a black deposit on the negative end of the glower, which spreads gradually from the negative toward the positive terminal. As this deposit increases, the voltage of the glower changes somewhat, and the candle-power and efficiency fall off, owing to the poor light-emitting properties of the blackened portion. The life of the glower on alternating current is about 800 hours; with the same glower on direct current it is considerably less than this. There are, however, radical improvements being made in direct-current glowers.

A glower burns at a higher efficiency in its own heat—that is, in a globe—than it does in the open air. We shall refer again to this feature in connection with the multiple glower lamp. The glower is about as strong as a piece of porcelain of the same size, and it is difficult to break a short section. The terminals of a glower give off platinum black, which deposits on the globe; and, although this can not be wiped off with a cloth, it is easily removed in a variety of ways, so that the globe may be considered a permanent fixture in the lamp, and for that reason may assume fancy designs. When properly made, the voltage of a glower changes but slightly during its life, the tendency being to rise from two to four per cent in 800 hours. For a short time before rupture, the voltage rises rapidly until the glower is broken.

The characteristic of a glower with reference to voltage and current is remarkable, and has given rise to the necessity of a steadying resistance. As the current in the glower is increased, the voltage across its terminals rises, at first rapidly, and then more and more slowly to a maximum, beyond which it again drops off with increasing rapidity as the current and resulting temperature through the glower continue to increase. Beyond the point of maximum voltage, the decrease in resistance of the glower is so rapid as to make the current difficult of control. In fact, without a steadying resistance, such a conductor would rapidly develop a short-circuit and flash out. The characteristic of a Nernst glower is shown in curve 1, Fig. 1, the small circle situated near the crest of the curve representing the point of 1.76 watts per candle in the open air.

In studying the characteristics of the

*A paper read at the Annual Convention of the American Institute of Electrical Engineers, Buffalo, August 23, 1901.

EXPLANATORY NOTES — The Hefner unit of candle-power has been adopted in this paper so that ready comparisons may be made with results obtained on the Nernst lamp in European countries.

Names of parts in the Nernst Lamp:—The "glower" is the filament or light-giving body. The "ballast" is a steady resistance connected in series with each glower. The "holder" is the removable piece containing glowers and heaters. The "heater-porcelain" is the porcelain disk in the holder immediately back of the heater. The "heater-case" is a small glass globe used in the six-glower and thirty-glower lamps.

glower and seeking for methods of operation under the best possible conditions, we naturally exploited the field in various gases including a vacuum, and although the experiments in this direction have not been exhaustive from a scientific standpoint, the results have been negative as far as practical results are concerned, and

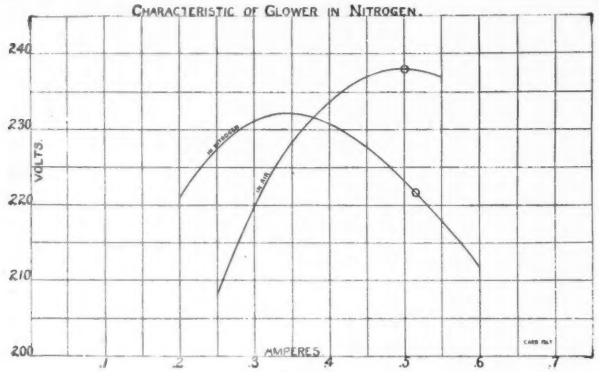


FIG. 2.

have demonstrated that, for the present, at least, there is nothing to be gained in this direction. The vacuum curve and corresponding air curve are shown in Fig. 1. Aside from the fact that the vacuum has shifted the point of 1.76-watt efficiency to a much lower voltage and higher current density, it will be observed that all the points of the curve now lie on one side, giving a decreasing difference of potential for an increasing current. Such a condition as this involves the use of a relatively large steadying resistance, and renders the operation of the glower inefficient. Fig. 2 shows the nitrogen curve with corresponding air curve, and it will be observed, as in the case of the vacuum, that this gas has also rendered necessary a large steadying resistance and has thereby lowered the available efficiency of the glower. In Fig. 3 we have both the oxygen and hydrogen curves to compare with the air curve. It is interesting to note how closely the oxygen and air curves compare with each other, while the hydrogen curve shows characteristics similar to that of the vacuum curve requiring a large steadying resistance.

There is an interesting phenomenon connected with glowers operating in a space free from oxygen, and which seems to be especially pronounced when operating in a vacuum. Where oxygen is excluded, the glower seems to be sluggish and to respond but slowly to changes in line voltage. The curves in Fig. 4 show this sluggish action in a vacuum. The line voltage is indicated by a dotted line in the upper part of the diagram, beginning with 270 volts. The upper solid curve shows the change of current value during a lapse of time indicated in minutes; while the lower curve shows the change in voltage on the glower during the same interval. Previous to this test the glower had been run at 0.25 of an ampere for half an hour, after which the line voltage was raised 20 volts and the current values and differences of potential on the glower were taken at intervals for 10 minutes, resulting in the curves shown. Shortly after the completion of this test, the line voltage was lowered 20 volts, when the glower again adjusted itself slowly to the new conditions, and returned to its original current and difference of potential. In air, the glower would have responded almost immediately to similar changes in line voltage. It is likely that the slight changes in both cases after the

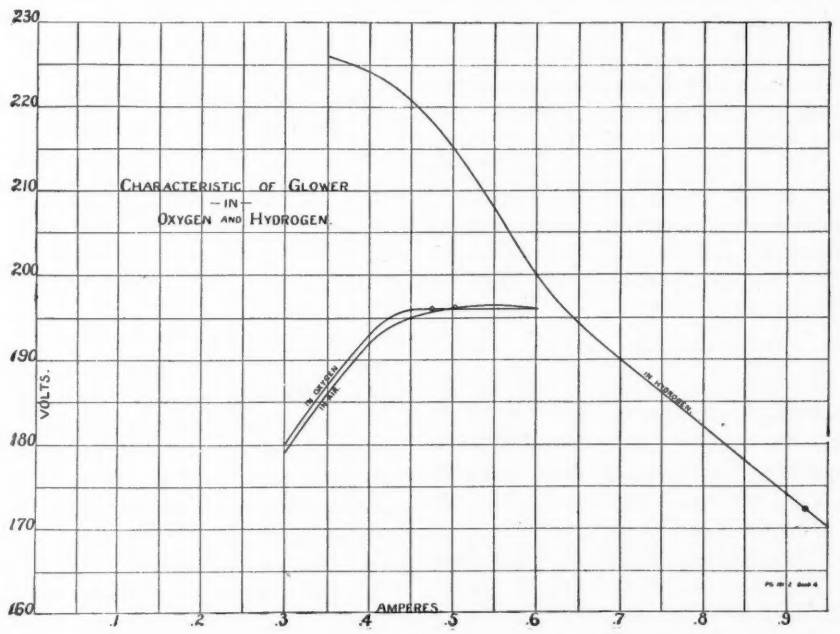


FIG. 3.

first minute are largely, if not entirely, due to the temperature correction of the resistance that was connected in series with the glower.

STEADYING RESISTANCE OR BALLAST.

The advantage to be gained by the use of a steadying resistance which would enable the glower to be operated efficiently at a point on or beyond the crest in the characteristic curve was well recognized. To accomplish this under all conditions of commercial use, and with as little loss as possible under normal conditions, the steadying resistance should have as large a positive temperature correction as possible and this temperature correction should always be immediately available. For example, if the glower were operated on or beyond the crest of the characteristic, the current could obviously be controlled by a sufficiently large steadying resistance having no temperature correction, but such resistance would very materially decrease the net efficiency of the glower. On the other hand, if the resistance is assumed to have a high temperature coefficient, the necessary steadying resistance under normal conditions may be very much less than when no temperature correction is present, and then should there be an increase in electro-motive force above normal, the corrective power of the steadying resistance would be brought into play to check any abnormal flow of current through the glower; in other words, to take up the additional voltage. As already stated, however, the temperature correction should be *immediately* available, for if it were not, the glower would "shoot over" when lighting above the normal pressure, that is, take more current at the start than it would a little later after the temperature correction of the steadying resistance had asserted itself. The same would also be the case with any sudden increase in the electro-motive force applied to the glower, unless the corrective power of the steadying resistance were immediately available to check the current flow.

Mr. Potter has designed a steadying resistance or "ballast," as he has named it, which is certainly unique in construction and which meets in a very effective manner the peculiar requirements of the glower. Iron wire is used on account of its high temperature correction, and by properly mounting this in a small glass tube filled with some inert gas, he has secured a ballast having at once a high corrective power with minimum resistance under normal conditions, and oxygen being entirely excluded the wire can readily be worked throughout the entire high corrective region without danger of destruction. This remarkable characteristic of the ballast is well shown in Fig. 5, from which it will be noticed that for a 10 per cent rise in current, the resistance of the ballast increases 150 per cent, so that a glower thus protected becomes at once operative throughout a wide range.

THE HEATER.

As already stated, the glower is a non-conductor when cold, becoming, however, a conductor when heated. For practical service in a lamp, therefore, it is necessary that some means be provided for heating the glower and bringing it to a conducting temperature. This topic could well form the subject of a paper by itself, but time will permit me to review but briefly the developments made in this direction. Some of the lamps which Dr. Nernst brought with him from Europe were fitted with electric heaters, while others were intended to be heated by an alcohol lamp or even by a match. The further refinements of the lamp imposed new and severe requirements upon the heater. It is, therefore, especially gratifying that we can announce the construction of a simple, satisfactory and effective heater, suited to the requirements of the latest forms of the lamp. The glower is lighted at a temperature of about 950 degrees centigrade, and it will be readily apparent that to acquire such a temperature quickly and without rapid destruction of the heater and adjacent parts, renders the selection of the materials a very serious problem. Platinum for the heater seems an undesirable expense in a commercial lamp, and, although many attempts have been made to devise a cheap mineral heater, platinum still holds its own as the least expensive, the most durable, and, altogether, the most desirable material for this purpose. The actual expense, however, is not so serious, because when the platinum heater is burned out, the value of the scrap is nearly 90 per cent of the original cost, and as the labor is almost negligible, the running cost of the heater is small.

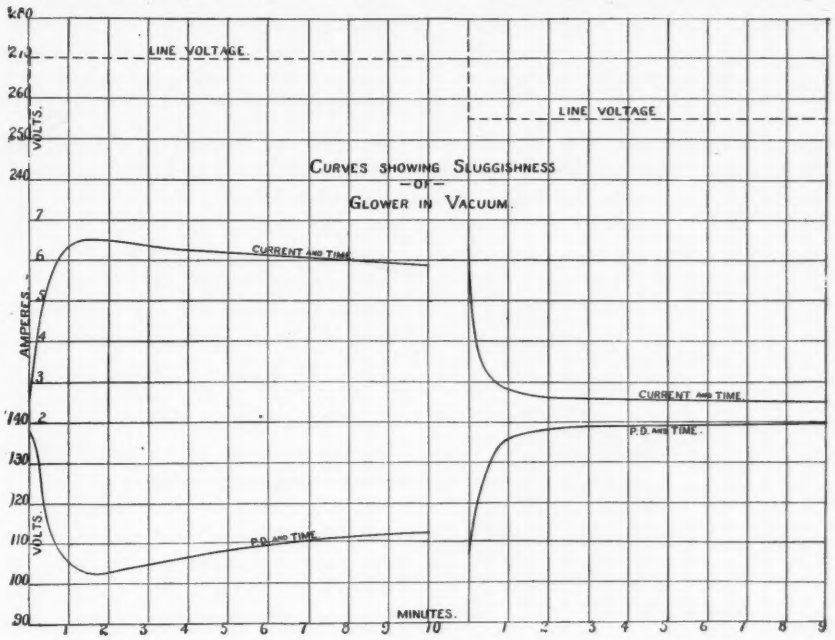


FIG. 4.

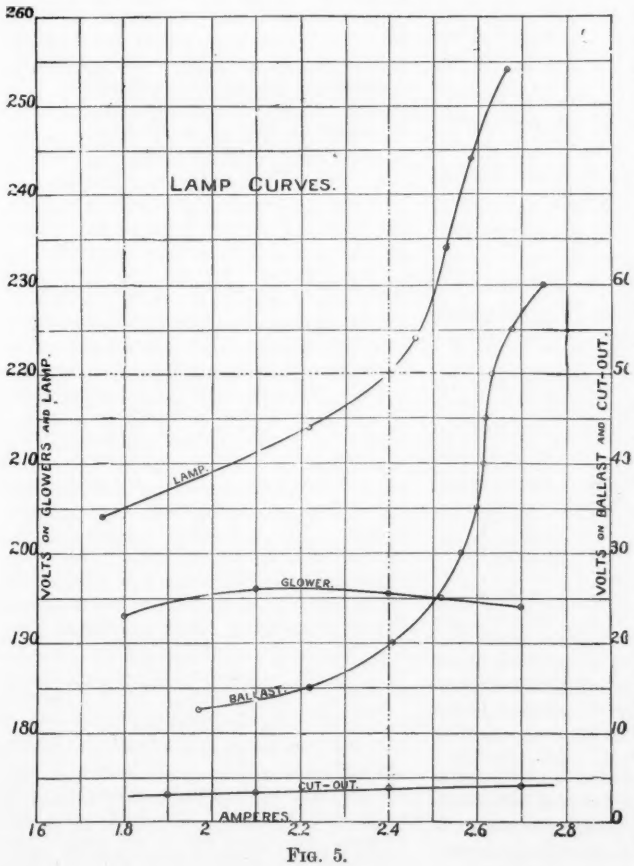


FIG. 5.

As now constructed the heater consists of a thin porcelain tube overwound with a fine platinum wire pasted with cement, the latter serving as a protection to the platinum wire from the intense heat of the glowers. These tubes are wound for 110 volts and are connected in pairs of two in series according to the service, the one, two and three-glower lamps taking one pair, and the six-glower two pairs. These heater tubes are mounted on a porcelain support in such a manner as to afford easy access for repairs without removing the glowers. The life of the heater when running continuously is about 200 hours, or 133 hours when the current is turned on and off 4,000 times at regular intervals.

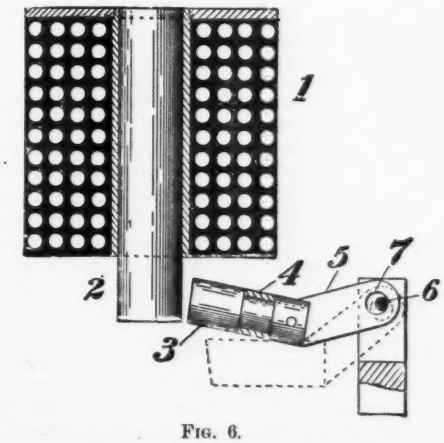


FIG. 6.

Inasmuch as the heater is not called into service for more than about 30 seconds to light the glowers, this would indicate a practically infinite life. In actual service, however, the heater remains in close proximity to the glowers and the high temperature to which it is thereby subjected causes a material decrease in its life. Nevertheless, the life of the heater is surprisingly long, probably several thousand lamp-hours. The average life, however, can not be definitely determined until a large number of lamps have been operated over a very considerable period in general commercial lighting.

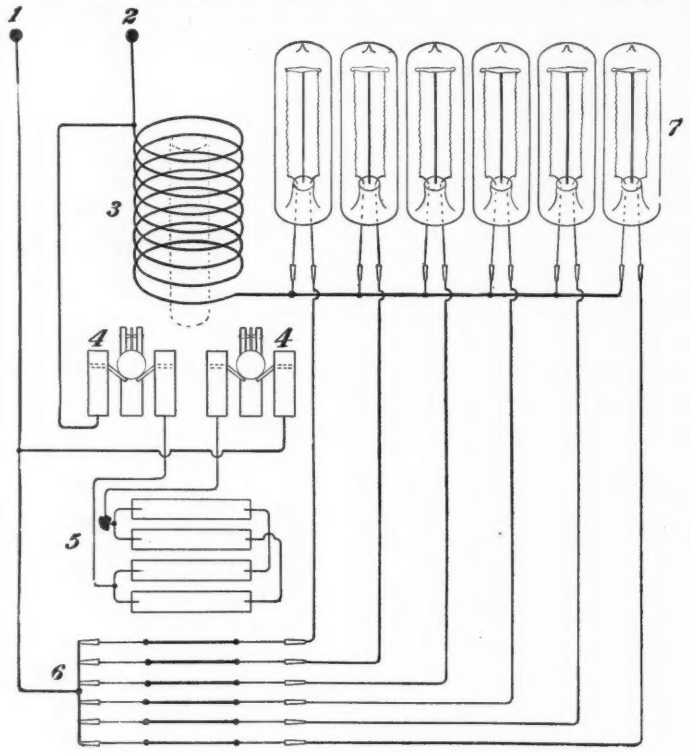


FIG. 7.

CUTOUTS.

An automatic lamp requires a cutout to disconnect the heater from the circuit as soon as the glower shall have lighted. This is another one of those details that Dr. Nernst developed and exhibited in some of his early lamps, but which we have sought to still further perfect and to adapt to the special types of lamp which we have constructed. The cutout includes a coil, a moving member and a contact, all of which must function at a temperature of about 110 degrees centigrade, without possibility of failure. The coil must therefore be heat-proof, the contact must not weld and the moving member should not hum on alternating current. These requirements are severe, but they have all been met in a most effective and satisfactory manner by embedding the coil in cement, by making the contact of silver, and by suspending the moving member from a single point of support.

The latter feature of the cutout is illustrated in Fig. 6; 1 is the coil; 2 the core; 3 the armature or moving member, which is round in section; 4 is a silver band, which makes contact by gravity with two silver wires not shown, forming a V; 5 is a strip of sheet steel, 0.007 of an inch thick, which is inserted into the armature and securely held by a pin; 6 is a small steel rod or support for the armature; and 7 is a hole in the steel strip 5, somewhat larger in diameter than the pin 6, so that when the armature is attracted by the magnet, there is practically only a single point of contact between the strip 5 and the supporting pin 6. This construction has resulted in a cutout which entirely avoids the humming sound so persistent in the ordinary types of alternating-current apparatus.

LAMPS.

The lamps thus far developed are indicated in the following table:

Candle-Power.	Voltage.	Number of Glowers.	Style
50	110	1	Indoor
50	110	1	Outdoor
50	220	1	Indoor
50	220	1	Outdoor
100	220	2	Indoor
170	220	3	Indoor
400	220	6	Indoor
400	220	6	Outdoor
2,000	220	30	Indoor

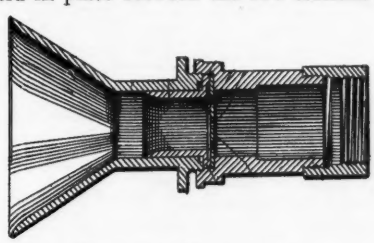
The main features are the same in all. The indoor lamps are provided with ornamental spun brass housings; the outdoor lamps with neat japanned cast-iron housings. Single-glower lamps have single-pole cutouts, whereas all the multiple-glower lamps are provided with double-pole cutouts, the reason for this difference being that the extremely high temperature in the immediate neighborhood of a number of glowers tends to establish leakage currents between the glowers and heaters, unless the latter be entirely disconnected from the circuit.

We will examine in detail the six-glower lamp as typical of all the others. This lamp is suspended from an eye-bolt, which, being removed, allows of immediate access to the inner parts. On removing the housing, we find that the ballasts are placed in a semi-circle around the cutout, the arrangements of the parts being such as to make all easy of access. The connections are made with small aluminum plugs on the ends of the interconnecting wires which avoid the many familiar inconveniences associated with set screws. All the parts are mounted on porcelain; in fact, there is no combustible material whatever in the lamp. The heaters and glowers are attached to a removable piece or "holder," the design being such that the heaters backed by a porcelain disk are immediately above the glowers, resulting in the following advantages: Stagnation of heat from the heater, thereby lighting the glowers in minimum time; no shadows, nearly all the light being thrown downward, where it is ordinarily most desired; stagnation of heat from the glowers, whereby the latter are run in their own heat and therefore at a higher efficiency than they would otherwise. The glowers and heaters are attached to the binding-posts of the holder by means of small aluminum plugs, so that the perishable members are always easily and conveniently interchangeable. The holder is provided with nine contact prongs, which, when the holder is pushed up into the lamp, automatically make the desired connections. These are shown in Fig. 7; 1 and 2 represent the line terminals; 3 the actuating coil; 4 and 4 the double-pole cutout; 5 the heater; 6 the glowers; and 7 the ballasts, there being, of course, one ballast for each glower. A small glass globe, called the "heater-case," is held by spring clamps around the glowers, the function of which is to retain the heat and thereby decrease the time of lighting as well as increase the efficiency of the glowers. In service, the "heater porcelain," which is the porcelain disk immediately above the heater, becomes coated with a thin layer of platinum black, unless measures are taken to prevent it, and this not only decreases the illuminating power of the lamp, but if not removed, will, in course of time, become conducting and cause leakage of current. No simple means have been discovered for removing the platinum black from the porcelain surface. This difficulty, nevertheless, has been avoided by coating the surface of the porcelain with a thin layer of white paste, which may be easily removed with a stiff brush or scraper. The platinum black now deposits on this coating, both of which may be removed together, leaving the fresh, white surface of the original porcelain to be recoated for further service; but even should the platinum black be allowed to accumulate, all danger of leakage currents is avoided by surrounding the holes through which the lead wires pass by small annular rings or grooves, it having been discovered that the platinum black will not deposit in these small spaces; the continuity of the platinum black surface between the lead wires is thereby interrupted. For higher candle-powers, the six-glower holder is used as a unit and this may be multiplied to any desired limit.

(To be continued.)

Electrical Patents

During this day and age microbes and disease germs, antiseptic devices of all kinds have been devised, and naturally inventors have turned their attention to telephones and similar instruments employed by the public generally. Perhaps the simplest as well as the most efficacious device is an antiseptic mouthpiece for telephones and the like recently patented by Mr. Adam Bergman, of Sacramento, Cal., which embodies a simple structure in the form of an attachment that can be applied to any well-known form of instrument. The attachment is made of two sections, which are screwed together, one being in the form of a neck that is attached to the instrument, the other having the usual flaring mouth. The antiseptic material, which is preferably formaldehyde, is placed upon an absorbent disk that resembles in all respects ordinary blotting paper, this disk being perforated and located across the passageway, and held in place between the two sections of

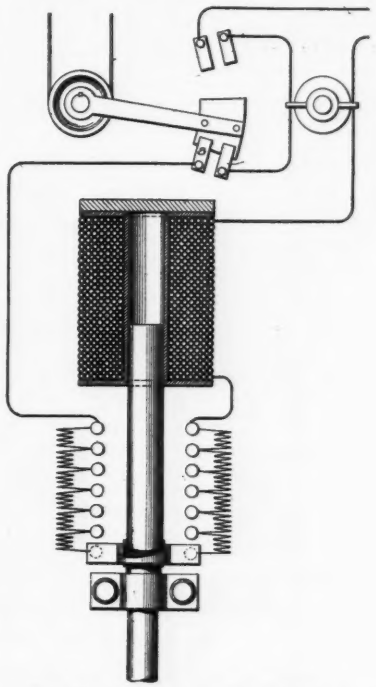


TELEPHONE MOUTHPIECE.

the attachment. The fumes of the formaldehyde, which is a well-known germicide, permeate the mouthpiece, and destroy any disease germs which may be exhaled by a person using the same. As these disks cost comparatively little, they may be changed as often as the impregnated solution becomes weakened.

A new lubricant for commutators has been protected by a recent patent issued to Mr. William Jones, of San Francisco, Cal. The compound consists of paraffin wax and graphite, to which is added a small quantity of spermaceti. In preparing the compound, the materials are taken at the ratio of five pounds of paraffin wax and three pounds of graphite, which are boiled together for about one and one-half hours at a temperature that is made as high as possible without burning the material. During this boiling a heavy black smoke is given off for an hour or more, after which the mixture boils quite colorless. This latter is continued for 15 or 20 minutes, whereupon a small amount of spermaceti is added, the mixture is then cooled in molds in the form of sticks of suitable size, and is ready for the market. The inventor states that he has been experimenting on the compound for some time, and found that while paraffin and graphite mixed together without boiling lubricate the commutators, they create a great deal of sparking at the brushes. This sparking he claims is due to the substance which is given off in the form of heavy black smoke above referred to, for the resultant product after the boiling creates no sparking except that which is occasioned by the defects in the commutator. The reason for adding spermaceti is to make the compound adhesive, as without it the lubricant is brittle and will not stick to the commutator.

Mr. Nils O. Lindstrom, the well-known inventor, who resides in New York city, has devised another improvement on an electric elevator controller. The invention is designed to quickly overcome the momentum of the actuating machine after the main circuit has been opened to stop the car. It is obvious that in cars traveling downward the tendency of the actuating machine to run after the circuit is opened to stop the car is greater than it is when the car is traveling upward, because in the former case gravity helps to keep the machine in motion, whereas in the latter case gravity acts against the machine and helps to stop it. In overcounterweighted elevators it is difficult, if not impossible, to ascertain whether the car with a given load in traveling up or down will aid the actuating machine in overcoming its momentum or will tend to increase the momentum, because it is not known whether the actuating machine is lifting the car or the counterweight. For instance, when the car is coming down with no load it is lifting the counterweight, so that in stopping, gravity acting upon the counterweight would aid the actuating machine in overcoming its momentum. On the other hand, if the car were descending with a heavy load gravity would increase the momentum of the machine. Hence it is desirable to provide an automatic device which will act properly under all conditions to overcome the inertia of the machine. Such a device must not stop the car too suddenly when gravity is promoting the stop, and not too slowly when gravity is tending to retard the stop. In accordance with the invention, a circuit is provided across the brushes of the actuating machine, which circuit is closed automatically when the main circuit of the actuating machine is opened to stop the car. This circuit contains a resistance and a solenoid in series, the latter adapted to cut out the resistance when the flow of current in the circuit is sufficiently great. When the main circuit is opened under conditions which would tend to keep the actuating machine running, as when gravity is promoting momentum, the current generated in the circuit is so great as to cause the solenoid to cut out the resistance at once, whereupon the heavy current then flowing will quickly consume the momentum of the machine and the elevator car will be stopped within a predeter-



ELECTRIC ELEVATOR CONTROLLER.

mined short time. On the other hand, when the main circuit is opened under conditions which would tend to overcome the momentum of the machine, as when gravity is against the momentum, the current generated in the circuit is not sufficient to cause the solenoid to cut out all, if any, of the resistance, and the momentum is overcome largely by the prevailing mechanical conditions, which bring the car to a stop in substantially the same time as under the previously described electrical conditions. Arrangements are made for the gradual cutting out of the resistance in order to avoid too sudden stops, and this is further promoted by the use of an air cushion, which retards the final movement of the device which cuts out the resistance.

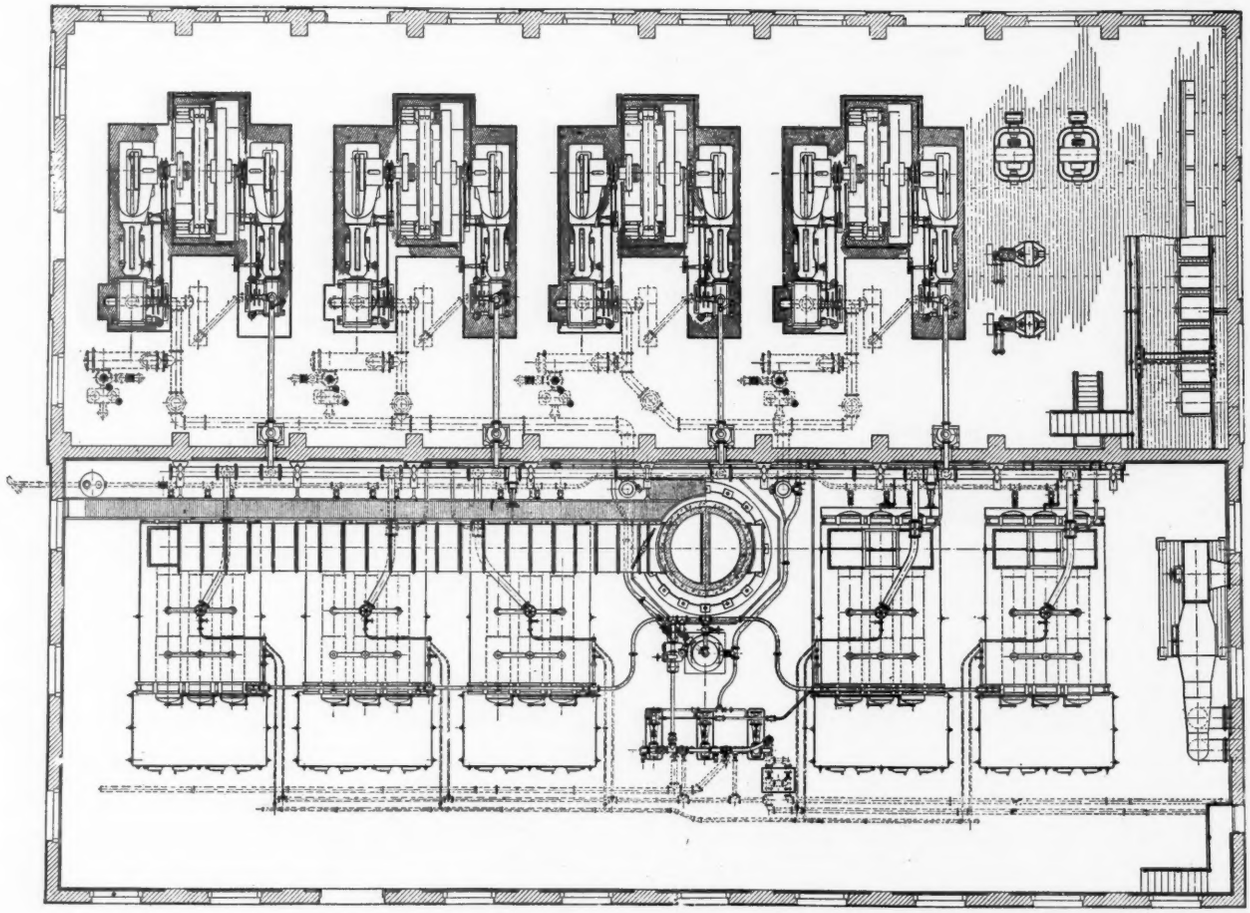
A wireless telegraphic apparatus has recently been put up both at the Takeshiki Japanese naval station in the Tsushima Islands and at the Shishi Cape in Nagasaki Prefecture, so that direct communications between the two points by means of this apparatus are now being carried on. Several experiments conducted between the two spots are said to have been a success in every case.

The Toledo and Monroe Railway.

A Modern Example of High-Speed Interurban Electric Railway Construction.

THE cities of Detroit and Toledo are both situated at the western extremity of Lake Erie and are separated by a distance of about 55 miles. The first step in their connection by electrical railway has been taken in the construction of the Toledo & Monroe Railway, covering somewhat more than one-third of the total distance, which was finished April 4, 1901. This line, in addition to being of interest as a link in the electrical system which will soon probably extend the length of the southern and western shores of Lake Erie, has additional interest as being an example of modern construction in every particular. It closely approximates steam railroad service in the speed, weight and frequency of its trains, and in the character of its road-bed and equipment.

For a number of reasons the situation of the power-house was made at a point near the River Raisin, in Monroe, Mich. While this is at one end of the present line, it will be not very far from the middle of the complete line to Detroit, and this point also enjoys the advantage of an abundance of condensing water from the river and good facilities for coal supply. The power station is well shown both in its exterior and interior by the accompanying reproduction of a photograph of the building and the sectional elevation and ground plan.



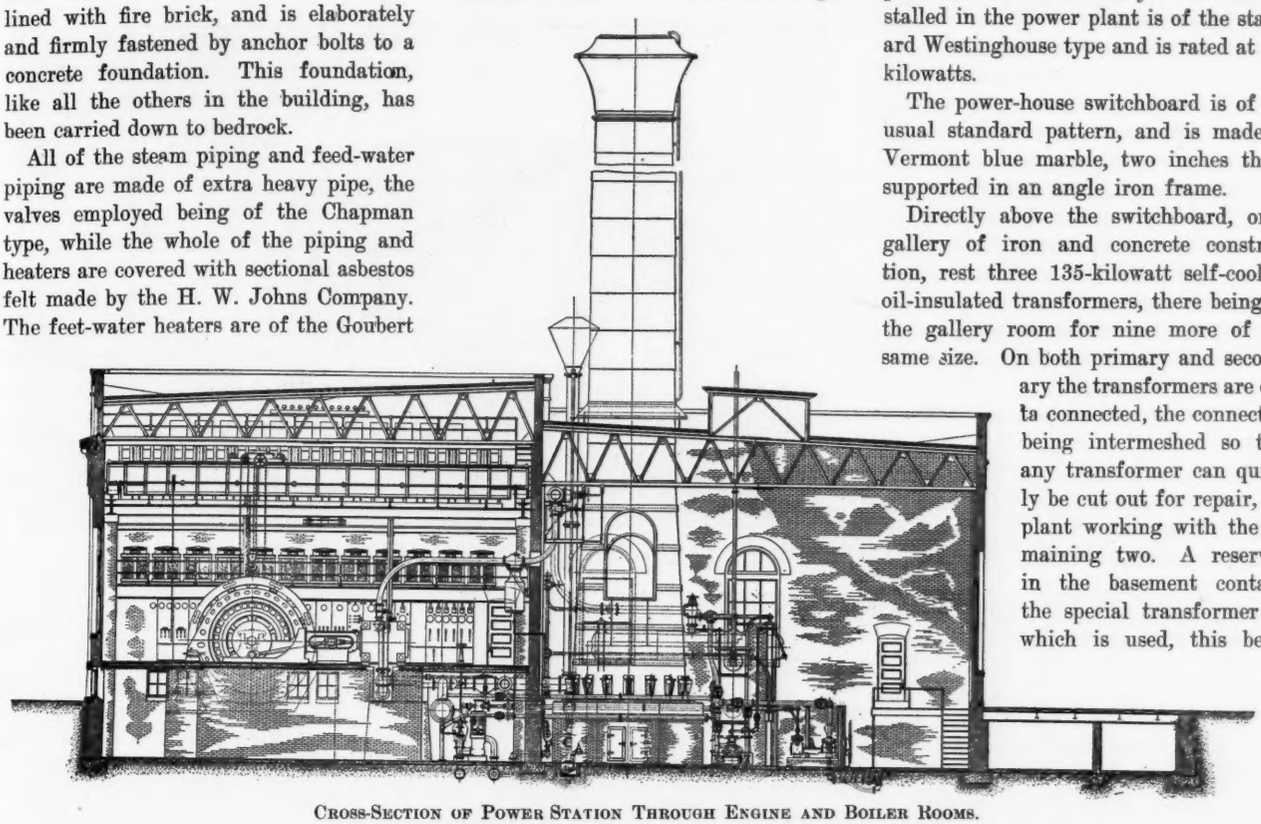
PLAN OF THE TOLEDO & MONROE ELECTRIC RAILWAY'S POWER STATION.

The power-house itself is a brick building, 150 by 109 feet in ground plan, and situated about 250 feet from the river. A division wall of brick separates the engine and boiler rooms from one another, making these two enclosures each 150 by 54 feet. The boilers will eventually be five in number, the present installation consisting of three units, each of nominal 400 horse-power, of the Babcock & Wilcox type. These boilers, while built for a working pressure of 160 pounds, are now operated at 135 pounds. Hand-stoking with West Virginia slack is the method of firing, the draft being controlled by automatic damper regulators of the Spencer pattern. Along the fire-wall runs the main steam header to which the boiler steam is led by curved pipes. Two Blake single boiler feed pumps are arranged for feeding, these being so connected as to work either through one or more feed-water heaters or directly into the boiler. The auxiliary heater is heated by exhaust from the exciter engines and pumps while the main heater is, of course, heated directly by the main exhaust. A governor is attached to the feed pumps so as to throttle the steam supply at a certain limiting pressure. Both city water and river water are available for feed purposes.

From the tops of the boilers runs an expanding steel smoke header to a steel stack, 9 feet in diameter at the bottom

and 6 feet at the top and 165 feet high. This stack is of very solid construction, lined with fire brick, and is elaborately and firmly fastened by anchor bolts to a concrete foundation. This foundation, like all the others in the building, has been carried down to bedrock.

All of the steam piping and feed-water piping are made of extra heavy pipe, the valves employed being of the Chapman type, while the whole of the piping and heaters are covered with sectional asbestos felt made by the H. W. Johns Company. The feet-water heaters are of the Goubert type, and the condenser, of the duplex vertical air pump and jet pattern, is of Blake manufacture.



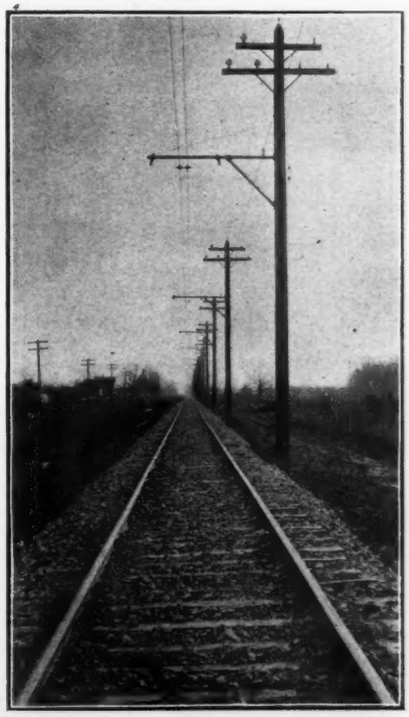
Cross-Section of Power Station Through Engine and Boiler Rooms.

The engine installation will comprise in the future four units, of which, at present, only one is in place. This is an 18 by 36 by 42-inch compound heavy-duty Hamilton-Corliss engine, made by the Hooven, Owens & Rentschler Company, of Hamilton, Ohio. This engine, running at a speed of 100 revolutions per minute, is rated at 600 horse-power. It is direct-coupled to a 400-kilowatt, three-phase, 25-cycle Westinghouse generator of the revolving field pattern. This machine generates current directly at 380 volts, which is the proper pressure for feeding rotary converters designed to give 600 volts on the direct-current side. For the distant distribution this pressure is stepped up by means of oil transformers to 15,000 volts; for the near sections of the line the current goes directly to the rotary converter. For exciting the generating set a 17½-kilowatt Westinghouse six-pole engine-type 125-volt direct-current machine is used, direct-coupled to a vertical engine made by the B. F. Sturtevant Company, of Boston, and running at 400 revolutions per minute. The rotary converter installed in the power plant is of the standard Westinghouse type and is rated at 200 kilowatts.

The power-house switchboard is of the usual standard pattern, and is made of Vermont blue marble, two inches thick, supported in an angle iron frame.

Directly above the switchboard, on a gallery of iron and concrete construction, rest three 135-kilowatt self-cooling oil-insulated transformers, there being on the gallery room for nine more of the same size. On both primary and secondary the transformers are delta connected, the connection being intermeshed so that any transformer can quickly be cut out for repair, the plant working with the remaining two. A reservoir in the basement contains the special transformer oil which is used, this being piped to the transformer cases. The latter are all connected electrically with one another and grounded.

Car-Barn of Toledo & Monroe Electric Railway.



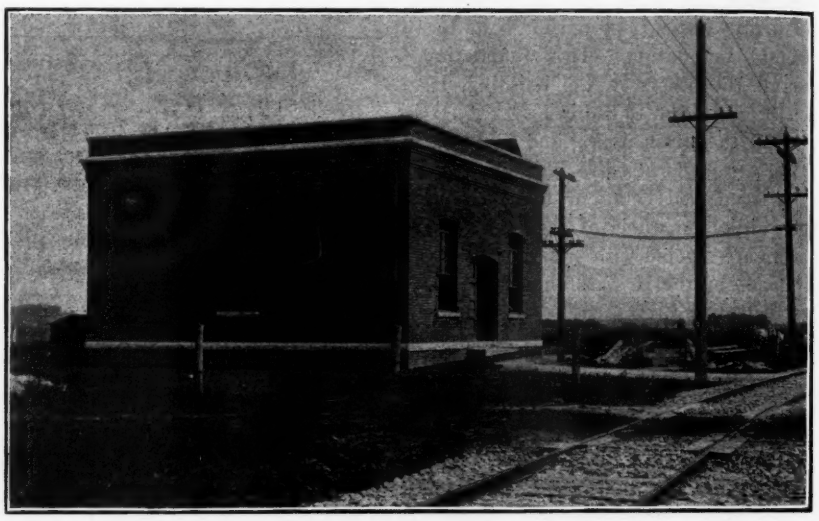
Section of Straight Track, Showing Ballast.

In another gallery are the circuit-breakers, one for each high-tension feeder. Choke coils and lightning arresters are in-

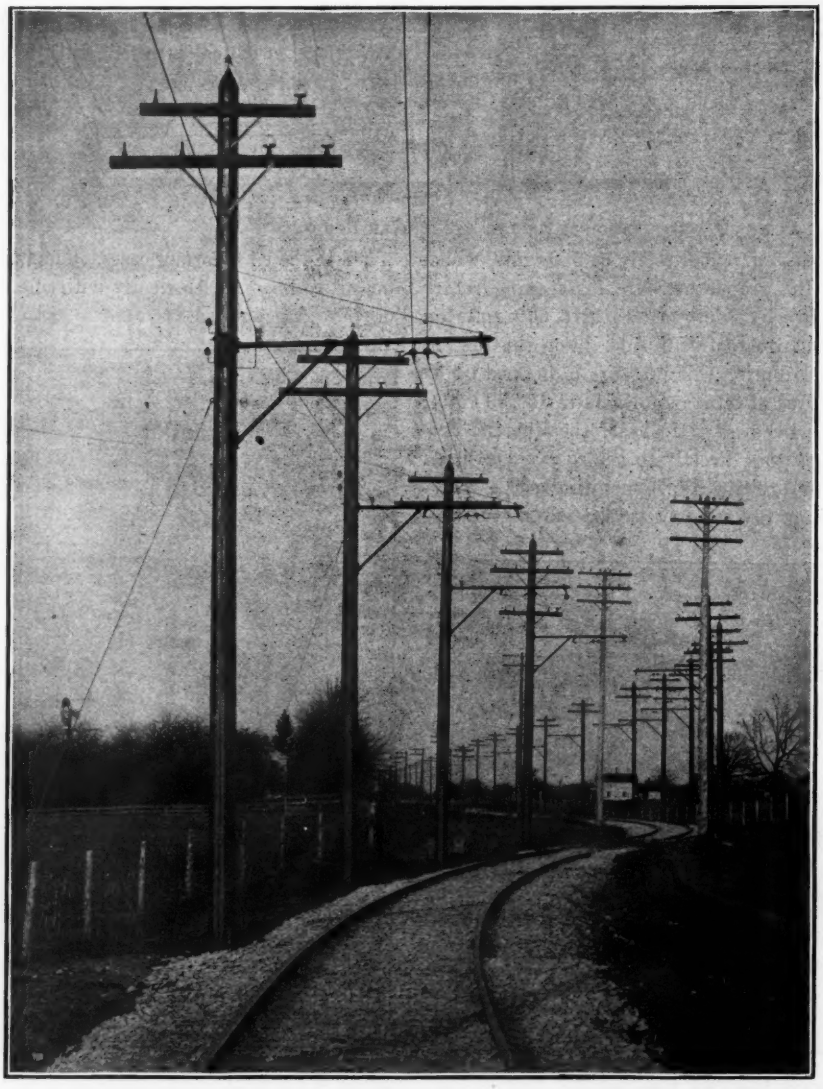
stalled in an upper gallery, to which the wiring runs without loops directly from the switchboard.

The power-house lighting is done by incandescent lamps working on the exciter current and enclosed arc lamps burning from the direct current furnished by the rotary converter. The electric light wiring is very carefully insulated and every precaution has been taken at the station to guard against fire. The floor of both engine and boiler rooms consists of concrete set in iron framework.

Along the line, which is about 21 miles in length, extends the high-tension feeder to a single substation located about one-third of the way from Toledo. This substation is shown in one of the illustrations and consists of a square brick building containing the necessary switchboard and two rotaries, together with three transformers, these being of the same



Substation No. 1, Toledo & Monroe Electric Railway.

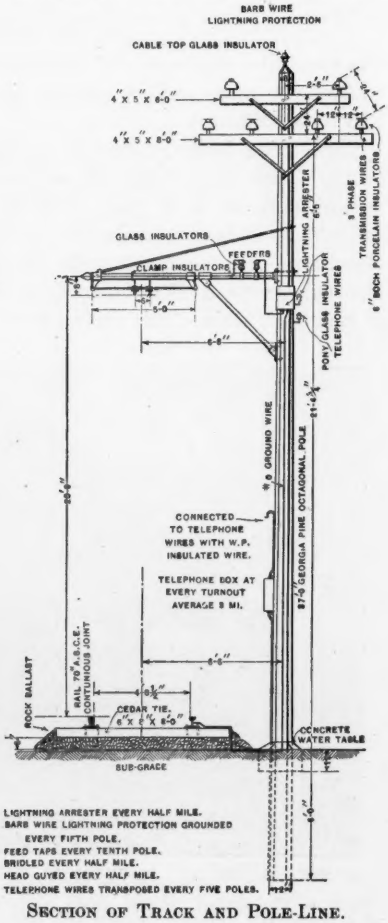


Overhead Construction on Curves, Toledo & Monroe Electric Railway.

sizes as the corresponding apparatus at the power-house. In a low gallery at the back of the building are the lightning arresters and circuit-breakers. The high-tension leads come into the building through clear glass tubes two feet long and one-half inch thick, inserted through a stone block.

The car house, of the usual pattern, which is shown in one of the illustrations, is situated near the power-house.

The pole work along the railway line is of two classes. From the power-house to the substation, 12 miles, the poles are of Georgia pine, sawed octagonal, each 45

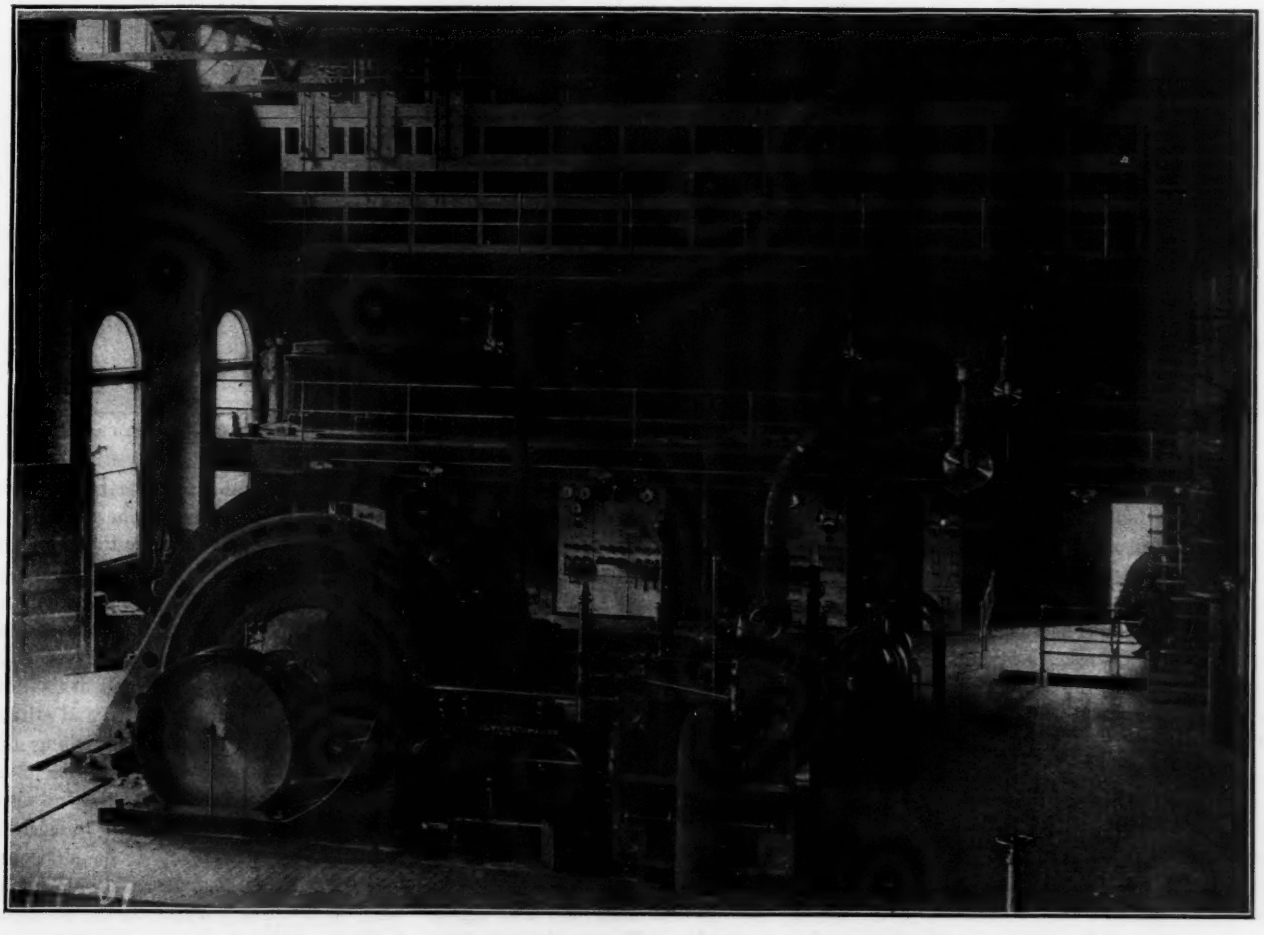

BARB WIRE LIGHTNING PROTECTION
CABLE TOP GLASS INSULATOR
4" X 5" X 6'-0"
4" X 5" X 8'-0"
GLASS INSULATORS
FEEDERS
CLAMP INSULATORS
LIGHTNING ARRESTER
3 PHASE TRANSMISSION WIRES
6" BOCH PORCELAIN INSULATORS
PONY GLASS INSULATOR
TELEPHONE WIRES
#0 GROUND WIRE
GEORGIA PINE OCTAGONAL POLE
CONNECTED TO TELEPHONE WIRES WITH W.P. INSULATED WIRE.
TELEPHONE BOX AT EVERY TURNOUT AVERAGE 3 MI.
ROCK BALLAST
RAIL 70# A.S.C.E. CONTINUOUS JOINT
CEDAR TIE. 6" X 6" X 8'-0"
CONCRETE WATER TABLE
SUB-GRADE
LIGHTNING ARRESTER EVERY HALF MILE.
BARB WIRE LIGHTNING PROTECTION GROUNDED EVERY FIFTH POLE.
FEED TAPS EVERY TENTH POLE.
BRIDLED EVERY HALF MILE.
HEAD GUYED EVERY HALF MILE.
TELEPHONE WIRES TRANSPOSED EVERY FIVE POLES.

Section of Track and Pole-Line.

feet long; beyond the substation the poles are only 30 feet long, since at this point

they have to carry only the trolley and feed wires, while between the power-house and substation they carry also the high-tension transmission line. All of the poles are set six feet deep, with a concrete topping which insures great rigidity and renders the use of guys unnecessary, even on curves. Every tenth pole is guyed, however, by head and bridle guys. The illustrations show the arrangement of one of the poles carrying the high-tension and railway wires. The pins are set so that the three wires of each high-tension circuit form an equilateral triangle with 24-inch sides. Boch porcelain insulators of the six-inch size are used, these being carried on wooden pins and double-braced cross-arms, as shown in the illustration. In the city of Monroe, the high-tension feeders are No. 0000 size, but beyond they are of No. 0 size. All of the low-tension feeders are of No. 0000 copper. Of these there are two from the power-house, one extending two miles and the other connecting the power-house with the substation. At the latter point three feeders emerge, one going two miles north, one two miles south, and a third four and one-half miles south. On none of the wires is any insulation attempted except in the city, where a weather-proof covering is provided. For the feeders green glass insulators are used, and at every twentieth pole a tap extends to the trolley wires. Lightning arresters of the Garton railway type are placed also at every twentieth pole, while along the top of the pole

THE TOLEDO & MONROE RAILWAY POWER-HOUSE.



IN THE ENGINE ROOM OF THE TOLEDO & MONROE ELECTRIC RAILWAY STATION.

line is stretched a barbed iron wire, grounded at every fifth pole. This ground is connected not only with the rails in the usual way, but also with a tinned copper plate two feet square set five feet deep.

A private telephone line is carried on the same poles on insulators mounted on iron brackets, this line being transposed about six times per mile to eliminate induction troubles.

The trolley lines are carried by gas-pipe extension brackets bolted through the poles. While the line of the railway itself is single a double trolley line is used, each wire being of No. 00 hard draw copper, this greatly facilitating the passage of cars at turnout points where one of the trolley wires remains over the main track, while the other runs out over the turnout track. The suspension insulators and other overhead fittings are of the types made by the Ohio Brass Company.

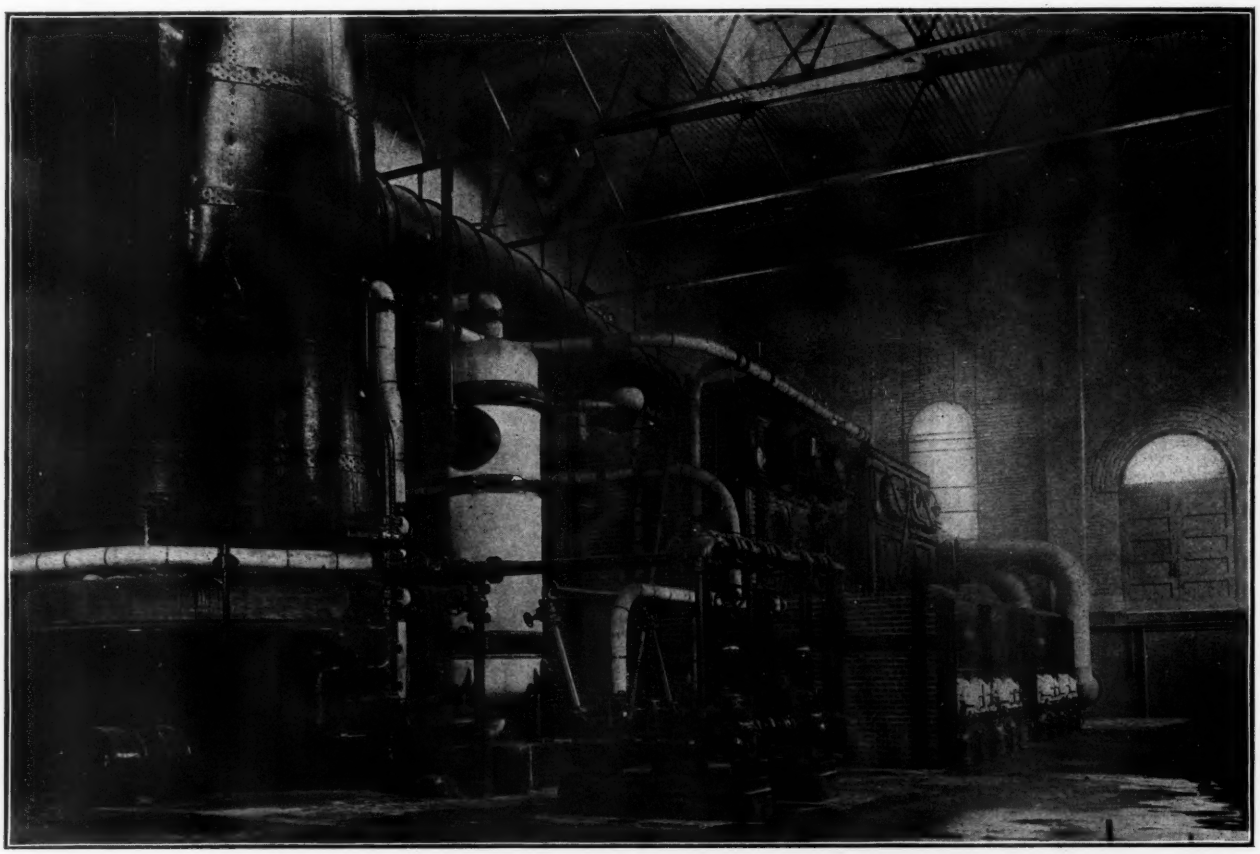
The track is laid with 70-pound T rails, furnished with continuous rail joints made by the Continuous Rail Joint Company, on oak and cedar ties two feet between centres. It is ballasted throughout with broken limestone and is maintained at a general height of about two feet above the surrounding country to give adequate drainage. The sharpest curve is only six degrees, while the heaviest grade on the line is only 1.67 per cent. The track is very nearly straight for its whole distance and the country is exceptionally flat and well suited for railroad construction.

All of the culvert and bridge abutments on the track are of concrete with a steel super-structure. Road crossings are protected by iron cattle guards and no railroads are crossed at grade. The line throughout runs on a private right of way.

The rail-connecting bonds are applied under the angle plates and the two rails of the single track are cross-connected at frequent intervals. It has not been considered necessary to provide any full copper return.

At present the rolling stock consists of seven cars, of which one is for freight alone, one is a combined baggage and passenger car, one a chair car and four ordinary passenger cars. The latter, which were built by the Jewett Car Company, of Newark, Ohio, are each 40 feet long and have a smoking compartment at the forward end. Each car is equipped with four 50-horse-power Westinghouse motors with incandescent arc head-lights and power brakes. The regular schedule speed from end to end of the road is 30 miles per hour, this requiring a maximum running speed between stations of 45 miles per hour. The cars are heated by electric heaters made by the American Electric Heating Corporation, of Boston.

The road was designed and built by Messrs. J. G. White & Company, New York, and is justly regarded as an admirable example of modern interurban railway construction.



Boiler Room in Main Station, Toledo & Monroe Electric Railway.

Towing by Electricity in England.

Towing by electricity along the river banks in England is quite a novel application of electric power. The experiment is to be tried, however, in the northern suburbs of London. The River Lea, which runs through Walthamstow, Tottenham, Enfield and numerous other places in that district is quite a busy little river with considerable barge traffic and it is now proposed to develop this traffic and stimulate manufacturing industries along the river banks by introducing a system of electric towing. It is stated that no electrical apparatus whatever will be used on the barge itself, which is to be connected by rope with an electrically propelled vehicle on the path working on the overhead trolley system.

The American Institute of Electrical Engineers' Annual Meeting—II.

Concluding Sessions of the Annual Convention at Buffalo—Highly Interesting and Valuable Papers and Discussions.

THE concluding days of the annual meeting of the American Institute of Electrical Engineers, at Buffalo, were full of interest and animated discussion. The proceedings in detail follow:

THURSDAY, AUGUST 22.

The meeting was called to order promptly by President Steinmetz, the first paper on the programme being read by Mr. W. S. Aldrich. This was entitled, "The Performance of an Artificial 40-Mile Transmission Line." This line closely represented an actual line, and the experiments upon it were largely to demonstrate that phase displacement is the worst enemy to good regulation. The details of research into the effect of phase displacement upon transformer voltage ratio were explained and the apparatus described at length.

The arrangement adopted yesterday—that papers be read in abstract in accordance with the programme and discussed in bulk afterward—was again made. The second paper was read by Dr. F. A. C. Perrine and was entitled "Elements of Design Particularly Pertaining to Long-Distance Transmission." This paper appears in full in this issue of the ELECTRICAL REVIEW.

The next paper in the list was entitled "The Induction Motor and the Rotary Converter and Their Relation to the Transmission System," and was read by Mr. Charles F. Scott. It was an interesting comparison of the relative merits of synchronous and non-synchronous motors.

Mr. Steinmetz then read his paper entitled "Theoretical Investigation of Some Oscillations of Extremely High Potential in Alternating High-Potential Transmissions." An abstract of this valuable paper will be given in a later issue.

On account of the absence of Mr E. W. Rice, Jr., President Steinmetz read his paper entitled "The Control of High-Potential Systems of Large Power." This will appear in a later issue.

Mr. Shepherd described some interesting conclusions from Dr. Perrine's paper. One is that a solid conductor is preferable to a cable; another, that aluminum is preferable to copper, on account of its greater size, after a certain point of voltage is passed.

Mr. Fisher described some tests to determine the effects of capacity in cables. He concluded that the flattening of the voltage curve due to capacity shown by Dr. Perrine was sometimes rather a sharpening, as he had noticed contrary results from those described.

Mr Emmett said the necessity implied in Mr. Scott's paper for designing generator, line and translating device as a unit was a limit to the usefulness of electric systems, and that he did not think the troubles referred to, when such a unified design was not made, were at all serious in practise. Rotaries and induction motors are working all over the world on all sorts of circuits, he said, and seem to be as "rugged" as other types of machinery. Mr. Emmett also spoke of insulation, and especially of the break-down strength of air. Overtones of the ordinary waves do not last long enough or have enough energy to rupture transformer insulation. Tremendous manifestations of energy have taken place on transmission lines, but rarely short-circuits in transformers.

Dr. A. E. Kennelly said, concerning Mr. Scott's paper, that there was a certain harshness shown to our old and useful friend, the synchronous motor. He believed both the availability and flexibility of systems would be bettered by using a variety of apparatus. Dr. Kennelly made a plea for the suppression of the term "rotary" in connection with synchronous converters. He spoke of the interest of Steinmetz's paper as showing how important the evanescent terms of the general equation of alternating current can become.

Mr. Steinmetz said, concerning Mr. Scott's paper, that he could not agree with the first part. For small motors the induction type is certainly preferable. He believed that there is no occasion ever to use an induction motor where one of the synchronous type can be employed. Mr. Steinmetz then took up various parts in Mr. Scott's paper, discussing it at length. He defended the synchronous motor and showed how it was of great practical importance to have these motors on the average circuit on account of the regulation possible through their agency. Mr. Steinmetz said that he had no use for wave-shape explanations of troubles with electrical apparatus, as his long experience has never shown this reason truly to explain such difficulties. The difficulty of operating synchronous apparatus depends very largely on the frequency. The synchronous motor has, in large sizes, rather the higher efficiency of the two, and can be built for very high potentials. The joint efficiency of step-down transformer and induction motor is much less than that of the synchronous motors, and the wider air-gap of the synchronous machine adds greatly to its mechanical stability.

Dr. Perrine spoke of his experience in operating both kinds of motors. He agreed with Mr. Steinmetz that no induction motor had been made using so little as one and one-half times running current for starting, and cited some cases in point which were very interesting. In California one of the earliest and most successful transmission plants is using synchronous apparatus throughout. The concensus of opinion among operating engineers on the Pacific slope was that it was preferable to use synchronous machines for large units. Another important point is that the synchronous motors can be used as dynamos. During a recent long drought in California, nearly every such motor in the state was running, steam driven, as a dynamo, thus saving the installation of much duplicate apparatus.

Mr. L. B. Stillwell said his experience had led him to prefer induction motors. Converters are, of course, necessarily synchronous machines. The power factor can be held better with the synchronous apparatus, but this, he thought, was their largest advantage. To avail of this skilled attendance is very necessary. He described the conditions of the Niagara line and stated that it was hard to find good enough men for the work at the wages that could be paid. He could not agree that the induction motor was a bad piece of apparatus. Short-circuits are inevitable, on any system, but the troubles due to them can be localized if the operating machinery is such as not to drop out of step instantly. As to wave form, the Niagara company has never had any

troubles due to this, although it is well known that the form of their waves is unusual.

Mr. Oberlin Smith referred to the growing importance of individual machine operating motors. For this work, if the alternating current is to be used, induction motors must naturally be adopted.

Mr. R. D. Mershon spoke of the work at Telluride, Col. Leakage, he said, was there discovered to be in proportion inversely to the radius of the wire employed. Roughening of the conductors by weathering adds largely to the effect. He leans toward the induction motor, but believes that each type has its uses.

M. Paul Janet, delegate from the Société Internationale, in response to an invitation from the president for his views on the subject, said he was deeply interested in the fine paper of Mr. Steinmetz, and had noted some of the same effects of voltage increase. He cited a case of a 6,000-volt transmission in France in which cables had been fractured several kilometres from the station by this effect. Accidents, however, are the most instructive phenomena that can happen, said M. Janet. He described an accident on a 12,000-volt, three-phase line containing a synchronous motor. The circuit was opened and the motor, running for a few seconds as a generator, gave out a current which resulted in a fatal accident. He thought some form of switch might be devised which would avoid these and similar accidents. M. Janet spoke in French.

Mr. Steinmetz said, in reply, that such reverse circuit-breakers are in operation already in the United States. He spoke also of the high-voltage leakage effects and believed a stranded cable would be perfectly applicable for the highest voltages. He had found that the maximum torque of the synchronous motor varied directly with the impressed voltage.

The various authors having made short replies the discussion closed at 2 P. M. In the afternoon a visit was made to the receiving stations of the Niagara transmission line in Buffalo.

On Wednesday evening the party again visited Niagara Falls, and, through the courtesy of the Gorge road, were taken in special cars to witness an electrical illumination of the Whirlpool Rapids. The effect of the white and colored lights on the fierce waters in the gloomy chasm was wonderful and was greatly admired.

FRIDAY, AUGUST 23.

The meeting was called to order at 10.30 A. M. by President Steinmetz and Mr. L. B. Stillwell at once presented his paper entitled "The Electric Transmission of Power from Niagara Falls." This was a long and very complete account of the history and engineering details of the enterprise. It will appear in full in succeeding issues of the ELECTRICAL REVIEW. Mr. Stillwell spoke for nearly an hour on the salient points of his paper, which was received with close attention and great interest.

Mr. Steinmetz complimented Mr. Stillwell upon this remarkable paper. He wished to know if the wave shape given in the paper was not taken at slow speed and questioned whether it would be the same at high speeds. He also wished to know if the efficiency measurements given were not made at low speeds and under other than working conditions.

Mr. Stillwell said the results of factory tests were elaborately checked under various conditions of load. The wave is considerably distorted by varying loads. As to the efficiencies, those given are electrical efficiencies.

Mr. Buck said the history of the Niagara Falls plant had been the history of electrical engineering for the last 10 years. Ten years ago few engineers agreed on systems, and men with money looked upon power transmission as more theoretical than practical. A large installation, such as Niagara, was needed to establish confidence. The low frequency was looked at askance, and the pressure of 2,200 volts was then twice that prevailing generally. Commercial feasibility of electrical power transmission was completely established by this superb plant.

Mr. Paul M. Lincoln spoke of methods of supplying power to the Union Carbide Company in connection with the heating of cables in ducts. Where rubber is subjected to constant static effects its deterioration is very high. As a case in point, there is a nine-thirty-seconds inch insulation rubber cable in porcelain clamps held by two boards on a brick wall near the power-house. Tests showed it to be reliable at 70,000 volts. After a week's service at 13,000 volts it broke down, and he thought this might be caused by ozone due to the static effects.

Mr. Elmer Sperry said ozone certainly would attack rubber. Hose with five-eighths inch thick wall, of the best rubber, when carrying air with only one and one-half per cent of ozone, will only stand two days' service.

Dr. F. A. C. Perrine spoke of the difficulty of temperature measurements. He thought the proper method of specifying apparatus should be that the maximum temperature at any point should not differ from the average temperature more than a certain fixed amount. As regards insulator pins, the stupidity of using telegraph sizes for heavy transmission lines is apparent. He told of a case where Western Union pins had been used with heavy insulators, and the latter, when screwed in place, actually rested on the cross-arms.

Speaking of breakdowns, he said that as regarded normal troubles, such as failure of machines, a more correct design of machines might limit them. In his experience the best means of avoiding malicious interference with the line is the newspaper, containing articles classing shooting at insulators and throwing bale wire over the line with deliberate homicide or cold-blooded murder, as the persons damaged most were the operatives of the plant and not the capitalists who owned it. He thought the failure of sleet to form on the line is due to heat rather than to electrostatic effect. He described a case in which icicles were formed in all directions on a high potential line, even straight up.

In response to a question Mr Stillwell told of anchor ice troubles at Niagara. Some hydraulic engineers had said the plant should stop when the ice formed, but they had simply opened the gates and pulled up the straining grills and let the anchor ice go through. In regard to operation and the causes of troubles and interruptions, those from cables were 30 per cent of the total; those from failure of exposed contacts formed another 30 per cent. These we may hope to eliminate. Doubling the pressure recently increased them, of course. The troubles due to errors in throwing switches amounted to 10 per cent. Where cheap men are in charge this can not be much bettered. Outside interference caused about 10 per cent, and lightning 20 per cent. This is a high figure, but is the result of experience. One flash shattered five poles and their fittings on the Niagara line.

Probably errors can not be much reduced. Outside interference has caused the company to patrol the line, employ detectives and patrols, etc.

Mr. Steinmetz called on Mr. Perrine for his experiences in lightning protection.

Dr. Perrine said his experience had not been large. On the Pacific coast the storms are not severe, but are frequent, and scattered all through the year. Very few storms there actually strike poles. Lines there are long, up to 154 miles, and one transmission is 198 miles. Under these conditions there is more or less lightning induction trouble all the time. To guard against this choke coils and lightning arresters are used. He thought choke

coils were principally of use in inducing people to buy more lightning arresters. On these lines a barbed wire, grounded at every fourth pole can be used with excellent effect. It seems to keep the line continuously discharged. In the California climate stray charges gather on the lines in any weather. The barbed wire is useful in permitting safe working, as one can not touch the line, even if disconnected, under ordinary conditions. Smooth wire would not be so good as barbed wire. The line is charged by air friction and the points or barbs constantly discharge it. One storm swept across a 46-mile line and left it the only one standing in its district. No fireworks were visible at the arresters, and he thought the barbed wire was responsible. He regarded it as the best protection against static and induction troubles.

Mr. H. G. Stott spoke of resonance effects on the Niagara-Buffalo line. Arcs of 100,000 volts are formed under some conditions. Mr. Steinmetz said it is difficult to assign the cause, but that it may well be due to short-circuits, which cause over-tone effects.

Mr. A. J. Wurts then read his paper entitled "The Development of the Nernst Lamp in America," this being illustrated by specimens of the lamps and their working parts.

In reply to a question, Mr. Wurts explained some structural differences in the various sizes.

Mr. Carl Hering asked what would happen if a glower breaks and automatically cuts the heater in circuits.

Mr. Wurts said no provision was made for keeping the heater out of circuit in the single-glower lamp, but no harm will ensue if it is left in circuit several hours.

Replying to a question concerning the nature of the conductivity of glower filaments, he said it is generally believed to be electrolytic. No electrolytic action is exhibited on alternating current. Glowers at the end of their life show crystalline structure.

Mr. John Howell said Mr. Wurts and his associates were to be congratulated upon the work which they had done. The characteristics of the glower as shown are very interesting and the "ballast" application is extremely ingenious. He wished to know if there is any relation between the ignition and fusion temperatures. Replying Mr. Wurts said an evident relation existed, but that it had not yet been determined. Substances which will stand the highest temperatures are not commercially available because they are unstable.

Considerable discussion ensued at this point on the candle-power comparison of lamps of different types, but no points of special importance were brought out.

Mr. Howell said that, from Mr. Wurts's figures, the useful life of the Nernst lamp would be only about 100 hours. On account of the excess current for heating at starting, a short-circuit, cutting off current for a minute, would produce a heavy rush of current and blow fuses.

Mr. Wurts said that the direct-current blowers break at one terminal. Lamps do not cool off enough in four seconds to fail to light when current comes on again. In case of current off long enough to cool the glowers, say 30 seconds, the heaters act, taking some excess current. It has not been considered commercial yet, in the United States, to make lamps of less than 50 candle-power.

Mr. Steinmetz said that newly born commercial apparatus should not be compared with products that had been standardized after years of practice. We should look rather to the promise than the performance of such a novelty as the Nernst lamp, just coming out of the laboratory and taking its first steps in commercial use.

Replying to further questions Mr. Wurts said he did not know the nature of the black deposit that forms on the glowers. The temperature of the glower is about 2,500 degrees centigrade.

Mr. W. J. Hammer described his trip in Europe, and spoke of American work in developing the Nernst lamp. Getting rid of the spiral heater is a point of great importance. He wished to know if any compensation for the expansion of the glower had been arranged, also if any falling off in efficiency had been noticed in the first few hours of burning. He further described his visit to Europe and what he saw.

Mr. Wurts said the drop in candle-power of the glower is very slight. The glower and its leads are U-shaped and this takes care of the expansion.

Very little work has been done on the direct-current lamp, as it was not deemed wise to go in for small candle-powers or to parallel foreign practice. At present 300 hours is the life of a direct-current glower, but better performance is hoped for. He believed the Nernst lamp would be a competitor of the arc rather than of the incandescent lamp.

Mr. Stillwell spoke of the importance of this lamp as an illuminant on low frequency. The lamp, Mr. Wurts said, is perfectly operative on 25 cycles and no difficulty has been encountered except in the cutout which hums on 25 cycles. The glower is not brittle at high temperature, and probably would not break in cars or automobiles. Adjournment was taken at 2 P. M.

In the afternoon the party visited the Niagara Falls power-house and examined the electrical and hydraulic machinery in them.

SATURDAY, AUGUST 24.

The meeting was called to order promptly, and Mr. A. H. Armstrong presented his paper entitled "Notes on Modern Electric Railway Practice." Mr. Armstrong's paper will appear in full in a later issue. The paper was a strong argument in favor of direct over alternating-current motors for railway service.

M. Janet, the delegate from the Société Internationale, then took the floor. He said that, in leaving the session, he wished, on behalf of his associates, to acknowledge, with the sincerest thanks, the hospitality they had received, which left with them an ineffaceable remembrance. They had visited our great works and fine installations, had listened to the papers and reviewed the discussions, and they were filled with admiration and satisfaction. He was pleased at the growth of fraternal sentiments between French and American electricians, and wished he might see all the Institute's members in Paris again at an early day.

Mr. Steinmetz replied that the pleasure had been mutual. The meeting of men who had studied the same problems from different points of view is always of interest. Unity of feeling has replaced international misunderstanding, and engineers are daily becoming more closely akin, whatever their nationalities.

Secretary Pope then read resolutions of thanks to Dr. S. S. Wheeler for gift of library and to Mr. Andrew Carnegie for gift of money for maintaining it.

On motion of Mr. Mailloux the resolutions were unanimously adopted.

Mr. E. J. Berg then read his paper entitled "Electric Railway Apparatus." Mr. Berg's paper will appear in later issues of the ELECTRICAL REVIEW. The loud and persistent playing of a brass band on the portico of the building made it difficult to hear Mr. Berg's remarks.

At this point it was discovered that the use of the hall had been given to another association, who appeared in numbers and threatened the forcible ejection of the Institute. Possession being nine points of the law, it was decided to ignore this new manifestation and finally peace was restored by the departure of the intruders, who had found a meeting place elsewhere.

Mr. C. E. Gifford then described some extraordinary phenomena noticed on the Niagara line which bore upon the points of control of synchronous converters brought up in yesterday's discussions.

Professor Gustave Gillon, at the invitation of President Steinmetz, described some phases of railway work in Belgium and elsewhere in Europe. He gave an account of some three-phase installations in France and Switzerland, and described the methods of starting in use. Professor Gillon spoke in French.

Dr. F. W. Ch. Janisch spoke of the Berlin-Lichterfelde and Berlin-Zossen lines, describing the 200-kilometre-per-hour, 10,000-volt locomotives in use under experimental conditions on these lines at present. He described the side construction of the overhead lines in which the three elements of the three-phase line are strung one over the other instead of in a horizontal plane. Dr. Janisch spoke in German.

Mr. B. J. Arnold said he was glad the foreign visitors had spoken a good word for the three-phase railway, whose obsequies had been performed earlier in the morning. He felt, after much study of the subject, in favor of the alternating motor on railways. We have been too conservative in our method of considering railway practice. We must reconsider our methods when it comes to a case of heavy trains. When we have done so, alternating-current motors will haul our railway trains. While appreciating the work shown by the paper read, he wished Mr. Berg might have taken an example more fair to the alternating motor.

Mr. C. O. Mailloux said that once he had been saturated with affection for the polyphase system, but had lately become demagnetized, so to speak. The greater the schedule speed desired the harder it is to apply the polyphase motor. Mr. Mailloux spoke at length concerning the acceleration curves of the two types and drew the conclusion that the time is not yet ripe for the application of the polyphase system.

Professor Gillon spoke of the heavy grades and mountain railways of Switzerland, and cited examples where torque at starting is obtained up to 10 times that exhibited in running.

Mr. E. P. Roberts spoke of the conditions of electric railways in Ohio, where mixed service, express and local, has to be maintained. It is desirable to get rid of the substations and the labor costs in them. He felt disappointed at the results set forth in the papers. A study made on roads built and projected, ranging from 50 to 500 miles long, was indicative of the alternating being the better practice. He cited instances of schedules, giving data of car weights and power consumption and spoke at length, giving the point of view of railway operation on this important question.

Mr. Mailloux said things could not be well compared under different conditions. In his remarks he had had in mind speed up to 45 or 50 miles per hour schedule per local suburban service. He again referred to the difficulties involved by the slow acceleration of the polyphase current.

Mr. L. B. Stillwell said the subject is a very live one. We have not sufficiently studied the conditions of alternating-current traction. There are many different kinds of traction. While the direct-current motor will probably survive for street car work, the alternating-current motor will have a field in long-distance and high-speed railways. The converter substation is a point of weakness as well as a point of expense. In each substation a reserve must be held and sometimes this exceeds the total of generating machinery, as in the case of the Manhattan Elevated Railway in New York. While it is sometimes imperative to use high accelerations, they tend to cause tremendous overload fluctuations at the substations. In a case recently calculated this might amount to 10,000 horse-power in three seconds. He hoped the German experiments would throw some light on the subject. A fair figure of operating expenses, he said, in this country, is 60 per cent, of which the power cost is 18 per cent. If we use rotary converter substations on a large scale, the efficiency will be about 80 per cent. If the rotaries can be eliminated an overall gain of two per cent would be made, and this is hardly sufficient to warrant an experiment.

Mr. Arnold said Mr. Stillwell's conclusions were very sound, but did not alter his own opinions at all.

Mr. Roberts cited a preliminary study for a long road in which the substation costs exceeded by 50 per cent the generation costs.

Mr. Steinmetz said that the polyphase system was less efficient in transmission because of the low efficiency of the induction motor in service. Fluctuations are more serious with the polyphase system and of all apparatus stationary transformers stand overload the least well.

Mr. A. H. Pott, of London, by invitation, said that in England the attitude of engineers is simply that of looking on. There is a strong desire for something cheaper. In the bids on the London Underground system that on the alternating system was much the lowest, but he regretted that financial conditions would probably lead to the absorption of the line by an American syndicate, with the result that the alternating system would have no chance at all. (Laughter.)

Mr. C. F. Scott said the papers read probably represented the consensus of opinion of the authors and their colleagues. He agreed with the conclusions presented, which were the same that he had reached after several years of work in the same direction. Mr. Scott spoke at some length in regard to the close similarity of results attained by different investigators. He spoke of the position of engineers of the manufacturing companies who have been accused of suppressing the alternating system at the orders of their commercial departments, and resented the implication.

Mr. Stillwell said he hoped American engineers would not bury this question and allow such equipments as those of the elevated and underground roads in New York to be put in only to discover that a firm in Budapest had installed a system of lower cost and equal operative efficiency in London.

Mr. Steinmetz explained how the induction motor could not commercially restore energy to the line.

Mr. P. K. Stern spoke of long runs and express and said he felt that this was a field for the induction motor.

A member described a mechanical device for assisting the acceleration of induction motors.

Mr. F. S. Holmes spoke of the finality of alternating-current design and the fact that generators were practically perfect. These machines will not become obsolete in their lifetime.

Mr. Mailloux spoke of the increasing importance of data of air resistance of trains due to the rising speed of trains.

Professor Gillon spoke of the deductions of German engineers upon "boring" friction and "skin" friction of trains.

Messrs Berg and Armstrong made brief remarks in closing the discussion.

Mr. N. C. Sawers, of the British Institution of Electrical Engineers, thanked the Institute on behalf of himself and his associates for the hospitality and courtesies shown them in America.

The meeting adjourned at 1.45 P. M.

It would not be proper to close this account of the Institute Convention without a word of appreciation of the untiring efforts of Mr. E. H. Mullin, who as chairman of the committee of arrangements, bore the somewhat heavy burden of planning and arranging all the details of trips and entertainments. He did it so well that he deserves a very marked expression of gratitude from those who enjoyed the fruits of his labors.

Messrs. G. F. Seever, H. A. Foster, and C. E. Gifford also contributed no little, by their work in Buffalo, to the comfort and pleasure of the Institute.

ELEMENTS OF DESIGN PARTICULARLY PERTAINING TO LONG-DISTANCE TRANSMISSION.*

BY F. A. C. PERRINE.

The popular admiration of a big thing is not unwarranted from an engineering standpoint. The mere bigness of an engineering problem oftentimes introduces new elements into the solution. Ordinary methods of handling materials become impracticable when the size of the work passes that usually undertaken, stresses heretofore unconsidered become important and introduce great difficulties by reason of the extra precautions necessary in their consideration. The electrical transmission problem is no exception to this general rule, for, were it always necessary to consider all the phenomena involved in every electrical transmission problem, the solution for a great long-distance problem would be the same as that of the smallest piece of work, since the introduction of larger figures into an equation introduces no difficulties in the solution. But this is not the case. In short-distance work there are less terms in the equation than there are in long-distance work, and in handling extremely high potentials we must consider not only the electrical factors of safety, but also mechanical factors of safety, for the reason that good insulations are never materials of great strength, and can be relied upon for their mechanical properties only when the mechanical strains are unimportant in comparison with the size of the insulating pieces employed. Were it not for these considerations it might be more expensive to transmit 10,000 kilowatts 100 miles than to transmit the same amount of power a single mile, but to the competent electrician not more difficult. All of the phenomena which must be considered in short-distance work are introduced into long-distance problems in the same form. The difficulty in long distance transmission problems lies in the introduction of phenomena which are not new, but which, as has already been said, are important only in work of the latter class.

No new interpretation of Ohm's law becomes necessary as resistance rises and our lines become long, and the loss of energy over a wire of a given resistance due to its resistance remains unchanged, though, of course, we must always give due consideration to the false resistance effects that may be introduced by the size of the conductors employed. In the earlier transmission lines where distances of from 10 to 20 miles were considered, and voltages from five to 20,000 volts employed, investors hesitated to buy the amount of conductor material necesary to reduce the losses, to amounts of the order employed in short-distance work, and in consequence with resistance losses amounting to from 26 to 30 per cent. While the regulation problems were of great difficulty, the wires were small, and the false resistance or so-called "skin-effects" unnoticed. But with the continued success that has attended the introduction of long-distance lines, the investors who have had sufficient courage to approach the problem of transmitting great powers over great distances have felt it unnecessary to restrict the engineers in the quantity of material, and, in consequence, the most recent systems have employed conductors of such a size as to necessitate the consideration of these phenomena, a matter of no great difficulty to be sure, and one which only determines the limit of size of a single line. This problem has been further simplified by an agreement between the engineer and the investor that for permanence of supply duplicate lines seem almost necessary.

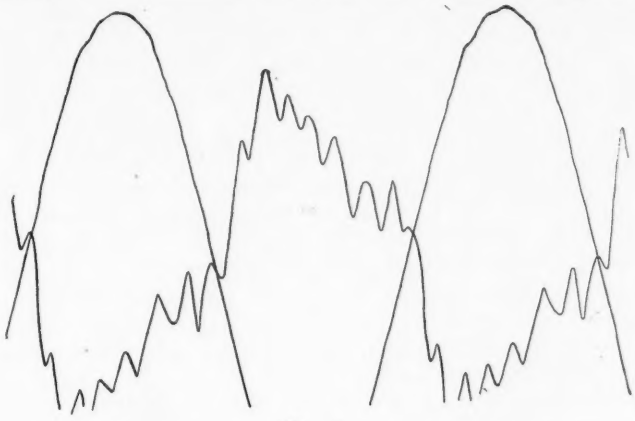


FIG. 1.

FIG. 2.

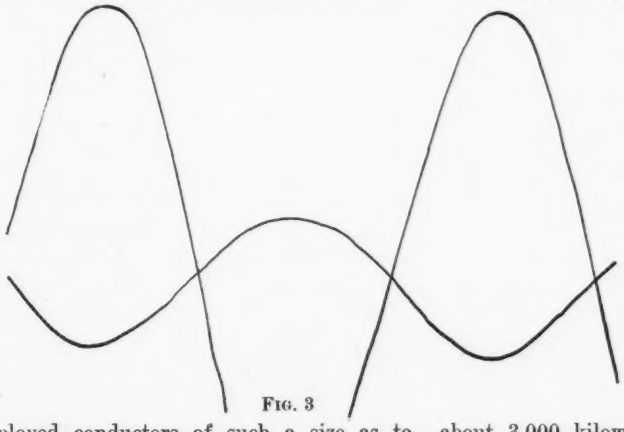


FIG. 3

Perhaps the most important question to face in the long-distance transmission is that of regulation. In working short lines, even with alternating currents, the regulation as the load changes is determined almost completely by the resistance effect. Occasionally when heavier currents are employed the self-inductive effects have to be considered, and generally the mutual induction from and to other lines becomes an important factor, though in determining the question of regulation the capacity effects are entirely unimportant.

Whether the lines are long or short, the current small or great, self-induction, mutual induction and capacity, as well as resistance, are ever present as phenomena. But while with short lines the capacity is the least important of these phenomena and is so unimportant as to be absolutely unconsidered, with long-distance lines it becomes the predominant factor. The importance of the capacity factor increases with the quantity of the charging current. This quantity, of course, depends upon the capacity of the circuit, the voltage employed and the periodicity. A long-distance line would be commercially unsuccessful were not the highest possible voltages used and the usefulness of the current rises, within certain limits, with the periodicity. Accordingly, in long-distance lines where periodicities are employed from which incandescent and arc lighting may be directly performed, high voltages entail very great charging currents, to such an extent that in a line of 100 miles in length, operating at a voltage of 50,000 or 60,000 volts and a periodicity of 160, the charging current amounts to something in excess of 2,000 kilovolt amperes, and employs such a proportion of the capacity at the station for charging the idle lines as to make the introduction of units smaller than 2,000 kilowatts inadvisable, and renders commercially impracticable the transmission of power less than about 3,000 kilowatts, unless the capacity effect be neutralized by the use of reactive coils.

Following the capacity in important effect on regulation is the self-induction. While the mutual induction may become another factor it is only considered in order to be eliminated by transposition of the wires, all of which leaves of the three final factors involved, the resistance of the line in the most unimportant place, though in sort-distance work it is the determining factor. The elimination of mutual induction by transposition is generally an exceedingly simple problem, for the reason that the lines are almost in-

*A paper presented at the Annual Convention of the American Institute of Electrical Engineers, Buffalo, August 29, 1901.

variably few in number, and follow each other with constant load for considerable distances, allowing the transpositions to be readily made at or between poles where every facility is offered for making them simply. The self-inductive effects, while important, and increased by the length of the lines, are nevertheless comparatively small in reference to the total amount of power transmitted, for the reason that the high voltages decrease the quantity of current, and as far as the line is concerned, the self-induction is rather a benefit than a detriment when the loads are constant, since the leading current due to capacity is relatively so large. Self-induction does indeed impair the regulation as the load changes and the more nearly the line capacity is balanced by outside inductances the more important becomes the effects of the self-induction except where the load is absorbed by synchronous motors, rotary transformers, or other apparatus which is capable of operating with a leading power factor, in which case the line capacity may be balanced by some form of load having a constant inductance and the line inductance balanced by a leading load variable with the reactance drop along the line. Indeed, were it always possible to install long-distance lines with a constant inductive load capable of neutralizing altogether the capacity effect, a variable synchronous motor or other leading load adjusted to neutralize at all times the self-induction of the line, the problem of regulation in a long-distance power transmission line would be reduced to the simplicity of the regulation in short direct-current transmissions. With variable loads the capacity and self-inductance effects can not truly be said to neutralize each other, for the reason that the capacity effect is constant, and the self-inductive effect variable with the load, and where a long line is loaded altogether with lagging loads the conditions for regulation are the worst possible. This will be explained later, as we now further discuss the effect of capacity. One of the most noticeable effects of capacity is its action in reference to the wave form of the generators. Should a peaked electro-motive-force wave form be delivered by the generators to a line containing a heavy capacity, the line would usually have the effect of somewhat neutralizing the generator defects, and will furnish to the translating devices at the delivery end of the line a smoother curve than was originally delivered by the generator, but where the generator curve is a sine curve, or, as is more common with modern types of generators, a curve with a slightly flattened top, the capacity tends to increase this flattening, at the same time in the current curve all harmonies are accentuated by the presence of capacity in the line and receiving circuit. The extent of this action is illustrated in Figs. 1 and 2, which are reproduced from oscillagraph curves taken by Professor E. E. Farmer, of the Stanford University, from the lines of the Independent Electric Light Company, of San Francisco. This company is not operating a long-distance transmission system, but its circuits being all underground are of a high capacity and, in consequence, the necessary points are illustrated by these curves. In Fig. 1 the smooth curve is the electro-motive-force curve at the generating end of the line. The rough curve being the corresponding current curve, the lines being unloaded except by reason of the capacity current. Fig. 2 is the same current curve as it is found at the point distant from the power-house along the cables.

The peaked character of the current curves in this case seems to be due to harmonics from the armature slots in the generator, since they correspond in number and position to these slots. That this is not due to any errors in the oscillagraph itself is shown in Fig. 3, which gives the electro-motive force curve taken with both the current and electro-motive-force windings of the oscillagraph in series, and shows that the two windings give corresponding results when operated by the same wave form, but displaced in phase 90 degrees. Fig. 2 shows at once by examination that the effect of the circuit has been to reduce the accentuation of the teeth of the current curve so illustrating the points made. The disadvantages that may arise from this condition were illustrated in the writer's practice in a line 45 miles in length, operated at 60 cycles and 25,000 volts. A synchronous motor was employed having a naturally bad wave form. The maximum point of the wave rising far above the point represented by the equivalent sine wave. In this case at no load the motor took full-load current and at full load a current much in excess of the normal. The difficulty was remedied by paralleling the lines at the delivery end with a reactance coil. These experiments have been described in detail by the writer in a paper presented May 17, 1900, before this society. These results have been borne out more recently by observations made on a 140-mile line supplying synchronous motors of a better design, one synchronous motor being of the revolving field type, and another of the inductor type. Both of these motors give a fairly correct wave form, and in neither of them the difficulty of the earlier experiments has been repeated, fortunately proving that the difficulty from modifications of the wave form in lines due to the capacity can be overcome by the choice of correct motors. By far the most important effect of the capacity relates to the regulation of the transformers and generators attached to the line: a leading current taken from such apparatus having the effect of increasing the voltage, while a lagging current decreases it proportionately. This has nothing to do with the drop in voltage from the line itself, whether on account of resistance or self-induction, or to the rise along the line due to the capacity, but refers only to the action of the generating apparatus, and it can readily be seen that where a line is operated sometimes with no load and sometimes at full load, the change of the power factor from leading to lagging will change the voltage beyond the calculated drop along the lines, and generally beyond the amounts allowed for in any regulating apparatus. Considering this point we see at once that regulation, the difficulty that was above spoken of, is due to the variability of the self-inductive effect in the line itself, and points to the conclusions that were above drawn of the perfect line being one in which the capacity of the line is neutralized by a constant self-induction and the variations of the load on the line. With lines of high capacity there is a rise in potential along the circuit, but though this effect has produced much discussion, its practical effect in importance is not very great, for the reason that it is entirely overshadowed by its corresponding effect on the apparatus which has just been described. In the case of the longest lines at present operated, this effect does not amount to more than 20 per cent of the rise in the step-up transformers produced by the same leading current.

As it has already been said, the highest possible potentials are necessary in order to restrict the investment in very long transmission lines. When the voltages rise above 30,000 volts, phenomena become important in the problem of insulation which below that voltage were unnecessary to consider. In the first place voltages from 25,000 to 30,000 volts can be readily handled with insulators of either glass or porcelain having a diameter not exceeding seven inches. Pieces of glass or porcelain of these dimensions are mechanically

strong and are readily manufactured. Where the voltage rises to 50,000 or 60,000 volts, and the sparking distance between the lines increases to between five and six inches, the insulators must have a diameter of at least 12 or 13 inches, and be held not less that seven or eight inches above the cross-arm. Such pieces of these fragile insulating materials are difficult to manufacture, and though the problem has been successfully solved, the greatest care in design and manufacture is absolutely essential, though it is believed that the factor of safety of high potential insulators as at present designed is by no means as great as that commonly employed with the lower voltages. An even more striking difficulty in handling high voltages lies in the effect of the electrical surface tension or density which, with high voltages and small wires, results in a brush discharge and high energy loss independent of leakage over the surface of the insulators, being simply to escape to surrounding bodies from the whole surface of the wire. This we believe was first taken into account by the engineers associated with the writer in carrying out high voltage work. Stated simply, it found that the electrical tension along the line operating at 50,000 or 60,000 volts renders the use of wires smaller than about three-eighths inch diameter a dangerous expedient resulting in important losses, which again points to the fact that high potential long-distance transmissions can not be successfully carried out unless the power to be transmitted is in itself large, warranting the use of conductors of great size.

The important phenomena which rise to view in carrying out the long-distance problem have now been presented, and it remains only to call attention to the fact that in this long-distance transmission work extraordinary precautions must be taken to maintain the permanence of supply. Long-distance transmission means, as we have said, large powers; and large powers delivered at distant points presuppose important engineering undertakings at the delivery end of the line which call for absolute continuity of supply. The poles must be selected and erected with more than ordinary care. The lines must be constantly patrolled. Trees can not be simply trimmed, but a right of way almost as wide as a railroad right of way secured, and all obstructions of the nature of trees which may fall across the line in high winds removed. The use of the ordinary insulating materials in power-houses and supply stations, such as paraffined wood and paraffined marble, must be entirely abandoned or relied upon only as minor auxiliaries, and, finally, wherever it is possible, either steam or storage battery auxiliaries at the delivery end of the line furnished. It seems almost unnecessary to call attention to the design of the apparatus in the generating station, but it is perhaps well to mention the fact that the generator and transformer designers may aid the installing engineer very materially by paying particular attention to regulation at the lower power factors even at the cost of some efficiency, should that be necessary. The designer should always remember that regulation in long-distance transmission is regulation at other than unity power factor.

The engineering problem, therefore, by its very bigness is one requiring the most careful solution at its every step, and the fact that it is being now successfully carried out merits the highest praise both toward the engineers in designing and the investors whose faith in their engineers permits the employment of the necessary capital to do the work thoroughly.

The points made in this paper have all at one time or another been particularly discussed before the Institute, and the writer only ventures to bring them together in this sketch in the hope that new points of view may be attained by their discussion in relation to the whole problem.

The Electrical Energy of Lightning.

To the Editor of the Electrical Review:

In your issue of August 3, 1901, I noticed a very interesting article relating to "Thunder-storms," written by Mr. Alfred F. Sims. I notice his statement, as follows: "The electrical energy is mainly converted into heat by the resistance of the air, the particles of which are instantaneously heated. The passage of the electrical current is so rapid that only a brilliant light streak, or flash, is visible."

This is, to a certain extent, true, as far as the human eye is able to discern while looking at the flash, which is momentary; but when viewed at leisure through the eye of a camera after the impression is permanently fixed so that we may study its convolutions and eccentricities, it becomes another story. The main discharge is so brilliant that we do not see the smaller discharges, which are extremely numerous.

The resistance of the air to the electrical discharge is shown very clearly in the upper left hand part of the picture I send you. There it shows itself practically tied up in knots. You will also notice in the main discharge that the zone of light which follows this is evenly distributed on each side of the main body of the incandescent matter.

A Lightning Flash, Showing the Resistance of the Air.

Another peculiarity is shown on the upper right-hand side, which shows that the discharge is like a ribbon, indicating the width of the discharge and the wave lines formed by the resistance to the air. In this particular picture, which was taken on July 22, 1901, at 10 P. M., you will notice that the main body of the discharge is from the upper left descending to the lower right, showing that the direction of the storm was from northwest to southeast, and also the direction of the currents of air, the lightning taking the path of least resistance. The direction of the storm was from northwest to southeast.

I would state that when this flash was taken not a drop of rain had fallen, but it rained some time after.

W. H. A. Davidson.

Baltimore, Md., August 20.

OHIO ELECTRIC LIGHT ASSOCIATION.

THE SEVENTH ANNUAL CONVENTION HELD LAST WEEK AT PUT-IN-BAY.

The seventh annual convention of the Ohio Electric Light Association was held last week at the Hotel Victory, Put-in-Bay Island, Ohio, on August 20 to 22, 1901.

The meeting was a very successful one, from point of technical merit of papers read and discussions which followed. The president of the association, Mr. Ernest J. Bechtel, of Toledo, has taken a great interest in the association's progress, and in his annual address presented suggestions of merit, which were adopted and made effective by the association. One of these was the admission of the manufacturers and supply men to associate membership.

He said, in part: "I sincerely believe that the greatest stride in our favor, and against our strongest competitor (municipal ownership), will have been taken when we adopt a correct system of uniform accounting. One which will allow us to determine the actual cost of our product, and by reason of uniformity have it comparable with our neighbor's, thus bringing out the weak points of one or the other, or perhaps both, and allowing them to be readily remedied. Our first step in this direction would be to educate ourselves to keep our books in such condition that by consulting them we can immediately see the actual condition of the business. Our greatest burden lies in showing and convincing the public that the mere operating expense is not the actual or true cost. When this is done, municipal ownership agitation and investigations will cease to be a nightmare to the electric light company."

The paper by Mr. W. D'A. Ryan attracted general attention, and presented some entirely new points of view. Mr. Ryan's invention of the luminometer is familiar to many.

Mr. Alex Dow, Edison Illuminating Company, Detroit, Mich., was in attendance upon the meetings and, by courtesy, was given the privilege of the floor. He combatted some of Mr. Ryan's positions, mainly because he contended that Mr. Ryan had too greatly emphasized the advantages of the enclosed arc lamp. He thought that Mr. Ryan had taken a view where all conditions were favorable to the enclosed arc, and compared its efficiency with the open arc when operating under unfavorable conditions, such as it is frequently subjected to in current practice, as admitted by Mr. Dow himself. He believed that where necessary for any company to retain its equipment of open arcs with a care a very good service might be gotten from them. It was, after all, he thought, mainly a question of finance, not at all a question of giving good street lighting, as the latter could be done efficiently by means of either style of apparatus. If a company, for financial reasons, did not care to add to their existing investment, but was willing to slightly or even to some extent increase their operating expense by using better carbons, etc., they could hold on to the old style of open arcs and give very satisfactory service with them. He stated, however, that he had in use only 43 open arcs as against some 1,500 enclosed.

Mr. W. F. White, of Cincinnati, thought the enclosed arc undoubtedly superior for street lighting. He spoke of the intense light near the lamp in the open arc, and the slight illumination at a point midway between lamps that hung at an average distance apart, as objectionable features with the open arcs. In closing the discussion, Mr. Ryan said that while the use of opal globes improved the distribution, it did not bring the steadiness up to the plane of the enclosed arc lamp.

Mr. Lehman B. Hoit, of Cleveland, at eight oclock on Tuesday night gave a talk illustrated by lantern slides, showing recent improvements in construction of alternating-current and direct-current apparatus for operation of the various class of machines, and explained the economy of use of the multiple voltage system of control; also use of rheostats for controlling the speeds of machines to which motors were directly connected. His views of the old-style workroom filled with belting was a commentary on the old style as compared with the running of similar machinery by electric motors. He claimed a saving by the system he illustrated over rheostat control where variation of speed is desired of about 90 per cent.

He was followed by Mr. M. E. Turner, of the Cleveland Electric Illuminating Company, with a paper on "Selection and Maintenance of Meters for Measurement of Electric Current." This paper brought out a very interesting discussion and became a sort of experience meeting in which the merits of various meters received a pretty plain overhauling. The necessity of renewing pivots as well as jewels was urged by Mr. Vaughen, of Schenectady, N. Y. Mr. Turner thought it preferable if a meter was found not to be working satisfactorily to at once take it out and substitute another tested meter. Mr. Vaughen thought it better to test the meter on the premises as less likely to impair the confidence of the customer in the meter. The abandonment of the old-style of slip with dial readings, or position of hands, was recommended by Mr. Turner, and a following of the present plan pursued by gas companies, where the figures are put down as read. Mr. Dow thought all the troubles which affect the meter are most likely to cause it to go too slow. The customer may be depended on to report when it goes too fast. He therefore recommended frequent inspections and efficient men to be in charge of meter tests, as revenue producing. Mr. Clarence Renshaw, of Pittsburgh, read a paper on "Suburban Electric Railways, Particularly With Relation to Central Stations."

Mr. J. H. Perkins, of Youngstown, corroborated many of Mr. Renshaw's statements from his own personal experience in that plant. He commended the rotary converter as an efficient apparatus. The troubles he had experienced at Youngstown had been due entirely to his engines, due to an uneven angular velocity. He recommended flywheels of largest size.

Mr. Dow thought when used for lighting that motor-generators were preferable to rotaries. Unsuitable setting of engine valves was often responsible for uneven running, causing the motors to pump.

Mr. J. Henry Hallberg, of New York, gave a paper embodying the results of his experience as to the principal methods of controlling alternating-current arc lamps in series, contending that the reactive coil system, in connection with the shunt lamp, possess most points of advantage to central stations. The paper was illustrated.

Mr. H. C. Wirt, of Schenectady, N. Y., presented a paper on "Transformers," in which he made recommendations to manufacturers and central station men to adopt voltage and frequency standards, so that data tables may be compared without the necessity for correcting them for uniform voltage. In comparing the economical operation of transformers the yearly cost should include interest and depreciation, and power consumption be made the basis of comparison.

Mr. White, of Cincinnati, in the course of discussion stated that in his opinion one cent per kilowatt-hour for core losses was a fair figure and four cents per kilowatt-hour for copper losses. The former extending over a period of the 24 hours, while the latter would average as to period about three hours.

The following new members were admitted: The Port Clinton Electric Light and Power Company; The Northern Ohio Traction Company, Akron; The Shawnee & Straitsville Electric Light Company, Nelsonville; The New Lexington Electric Light Plant; The People's Gas and Electric Light Company, Defiance, Ohio.

A valuable paper was read by Hon. D. L. Gaskill, of Greenville, Ohio, on "The Relation of Electric Light Companies to Municipalities from a Legal Standpoint."

The election of officers resulted as follows:

President, W. F. White, Cincinnati.

Vice-president, E. H. McKnight, Middletown.

Secretary-treasurer, J. H. Perkins, Youngstown.

Executive committee, H. C. Fogle, Canton; S. M. Rust, Piqua.

Finance committee, W. F. Raber, Mansfield; L. H. Thulen, Leetonia; F. E. Valentine, Urbana.

Advisory committee, D. L. Gaskill, Greenville; A. W. Field, Columbus; Samuel Scovil, Cleveland.

The selection of Mr. W. F. White, of Cincinnati, places at the head of the organization one of the progressive and broad-minded electric light men of the country, who will certainly add strength to the association, and no doubt increase its membership and influence during his administration.

Columbus, Ohio, on the invitation of Mr. A. W. Field, of that city, was selected as the convention city for 1902.

The closing paper was read by Mr. E. S. Pilsbury, of St. Louis, Mo., on the subject of "Single-Phase Alternating-Current Motors," illustrated by appropriate diagrams.

In the discussion Mr. Pilsbury was asked by Mr. Renshaw whether the simplicity to be gained by a reduction in the number of leads would compensate for the complexity brought about by the increased number of circuits which would be needed on account of this low-tension distribution.

Mr. Pilsbury stated that the motor-generators are only to be used for replacing the rotaries, and are not expected to carry all of the secondary distribution, but only that part of it which is at present being handled by rotary converters on the multiphase systems.

Mr. Renshaw said he did not think it possible to supply railway service from the same circuits with lighting service if such railway service is to be supplied by motor-generators driven by induction motors.

Mr. Pilsbury contended in reply that condensers will be likely in the future to occupy a much more prominent place in the field of electrical distribution than heretofore. The cost of the condenser does not exceed about $10 per kilowatt, and with motors whose power factor is above 90 per cent the condenser capacity required is only about 10 per cent of the capacity of the motor, thus bringing the expense within very reasonably limits.

Mr. Wirt insisted that the use of the condenser was required with single-phase motors, as tests which he had seen made showed that when motors are operated without condensers the starting and running currents are from two to three times greater than in similar motors with condensers. This has an important bearing on the economy of the station plant.

When condensers are used they usually require, he stated, the introduction of a compensator and the combined cost of condenser and compensator equalled about three-fourths the cost of the motor itself, so that a single-phase motor of a design that would be comparable with a three-phase motor is much more expensive than the latter. Yet there is an undoubted field for single-phase motors of small capacity.

Mr. Pilsbury said that the reason why some manufacturers place so much emphasis on the use of condensers in connection with their single-phase motors is that they require a very large condenser to secure starting power for them, and thus being compelled to provide the condenser they are inclined to place an excessive value upon its operation; while, in fact, it is no more essential a part of the motor than it would be of a multiphase motor.

Mr. Perkins said that his idea was that a generating plant should be so arranged that the distributing system could either be used multiple or single phase, or in combination. Under certain conditions the adoption and use of single-phase motors will prove satisfactory and be a saving to the operator. Had used single-phase and two-phase, both, for some years and had not had any trouble with either.

The question box contained the following questions:

1. "Has any one had any actual experience in hot-water plant from central stations? If so, will that party start a discussion?"

2. "Alternating enclosed arc lamps have been found to make mahogany furniture appear to be covered with a blueish white fine dust. Has any one a cure?"

3. "Kerosene lamps for street lighting, such as the Kitson or Petoskey system; has any member met them in competition; how dangerous a competitor are they?"

4. "Has the association ever gathered statistics of the number of mills levied in cities and villages for lighting under individual or corporation operation, and municipal? The favorable report of the former is of much interest. A man in each county could get the list."

5. "Supposing that you have a 2-000-volt line where the trees are so high as to make poles of proper length out of the question, and you are not allowed to trim the trees?"

6. "Information regarding the right of a municipality to make a company place its poles on the curb after having, through its council, ordered them put on the street?"

7. "Where lighting transformers are banked on either the two or three wire system, it is desirable to operate with secondary fuses. Does any one know of an inexpensive but reliable form of secondary fuse, box-open copper tipped fuses preferred?"

In reply to question No. 2, Mr. Ryan recommended a reduction in the size of carbons, or an increase in the current, or both; also recommended care in selection of globes and preference given to globes of greatest opalescence as having a tendency to filter more of the violet light.

Mr. Hallberg on the same subject said, that he thought the use of a seven or seven and one-half ampere lamp would overcome the difficulty; also shortening of the arc.

In answer to question No. 3, Mr. Ryan said that it is impracticable to install the Kitson light at a reasonable height, owing to the peculiar distribution of light, the maximum being well on the horizontal. The higher the light is placed the less distance it will penetrate; the ghastly color of the light was also very objectionable.

In reply to question No. 5, Mr. White instanced the law on this subject promulgated by the state commission on gas and electric light companies. A similar regulation should obtain in Ohio.

In discussion of question No. 6, an interesting matter was broached, the usage regarding placing of wires on poles of telegraph, telephone or electric lines, as to which should be hung lower. The general opinion seemed to be that electric wires were safest placed higher than the others.

After adopting suitable resolutions of thanks to the authors of papers and others who had contributed to the instruction and entertainment of the convention, the meeting adjourned to meet in Columbus in 1902, at a date to be hereafter settled upon by the executive committee.

The ladies' entertainment was looked after by Mr. Emil G. Schmidt, of the Sandusky Electric Light Company, who personally conducted an excursion around the Islands on Wednesday morning; also a visit to the Caves. Mesdames Bechtel, Perkins, McKnight and daughters, Scovil, Valentine, Hoit, Renshaw, Douds, Field and Gaskel were of the party.

The following were in attendance upon the convention:

E. J. Bechtel, Toledo Railways and Light Company, Toledo; A. W. Field, Columbus Edison Company, Columbus; D. L. Gaskill, Greenville Electric Light and Power Company, Greenville; W. F. Hubbell, Wauseon Electric Light and Power Company, Wauseon; E. H. McKnight, Middletown Electric Light and Power Company, Middletown; J. H. Perkins, Youngstown Gas and Electric Company, Youngstown; John M. Plaisted, Columbus Electric Company, Columbus; W. F. Raber, Citizens' Electric Railway, Light and Power Company, Mansfield; S. M. Rust, Piqua Electric Company, Piqua; Emil G. Schmidt, Sandusky Electric Light Company, Sandusky; Samuel Scovil, Cleveland Electric Illuminating Company, Cleveland; T. J. Smith, New Lexington Electric Light and Power Plant, New Lexington; L. H. Thullen, Leetonia Electric Light and Power Company, Leetonia; F. E. Valentine, Urbana Electric Light and Power Company, Urbana; Alex Dow, Edison Illuminating Company, Detroit; F. J. Alderson, Stanley Instrument Company, New York; Perry R. Boole, Electric Appliance Company, Chicago; H. B. Coles, General Incandescent Light Company, Cleveland; F. C. Colwell, General Incandescent Arc Light Company, Cincinnati; Chas. M. Crofoot, Pass & Seymour and Crouse-Hinds Electric Company, Cincinnati; H. J. Douds, General Electric Company, Cincinnati; Robt. E. Gorton, New York and Ohio Company, Warren, Ohio; J. H. Hallberg, General Incandescent Arc Light Company, New York city; W. J. Hanley, General Electric Company, Cincinnati; Lehman B. Hoit, Bullock Electric Manufacturing Company, Cleveland; Wagner Electric Manufacturing Company, St. Louis; H. E. Hull, Erner-Hopkins Company, Columbus; F. M. Knierim, the F. Bissell Company, Toledo; Chas. S. Kuntz, Post-Glover Electric Company, Cincinnati; Ray L. Lillibridge, New York; W. G. Nagel, the W. G. Nagel Electric Company, Toledo; Ernest J. Paradis, the W. G. Nagel Electric Company, Toledo; F. G. Vaughen, the General Electric Company, Schenectady, N. Y.; H. C. Wirt, the General Electric Company, Schenectady, N. Y.; W. D'A. Ryan, the General Electric Company, Lynn, Mass.

The route of the proposed British Government Pacific cable is straight from Vancouver to Fanning Island, 3,337 miles; thence to the Fiji group, and thence to Norfolk Island, all three points in a nearly straight line. From the latter island it makes a sharp turn to Queensland.

Rubber Cultivation.

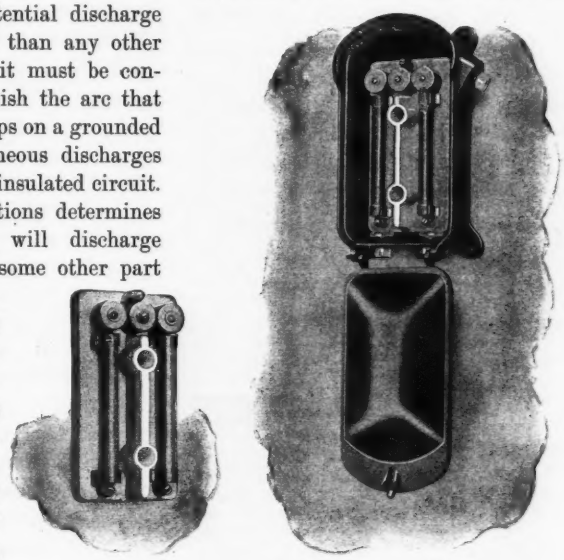
An interesting paper was read at the agricultural conference recently held at Barbadoes giving the results of some experiments carried out by Mr. J. H. Hart in the West Indies with a view to determining, among other things, the yield and quality of rubber obtained from rubber trees under special conditions, the trees most suitable for the climate and soil, the best methods of planting, the cost of establishing and the financial return which may be anticipated. All the most important rubber-yielding trees have been supplied to the West Indian Botanic Gardens by the authorities at Kew, and those under observation in Trinidad include the Central American tree (Castilloa elastica), the Para tree (Hevea brasiliensis), the Ceara tree (Manihot Glaziovii), the East Indian or Assam tree (Ficus elastica), several species of African rubber vines (Landolphias), and the West African or Lagos silk rubber tree (Funtumia elastica, previously known as Kickxia africana). The yield of rubber from Ficus elastica is small compared with that from the other trees, so that its cultivation in the West Indies is unlikely, while the climbing habit of the Landolphias renders them unsuitable for the purpose. The other four trees are much more likely to give satisfactory results, and have consequently received most attention. The Central American tree grows very freely in Trinidad, being most suitable for plains at low elevations. The largest tree in the gardens is over 75 feet high, with a girth of six feet at three feet from the ground, while in a small field at the experiment station, planted in July, 1898, the five best trees now average nearly 18 feet in height and 12 inches in girth. Experiments have been made to determine the yield and quality of the rubber, but the tapping was very carefully carried out so as not to affect the seed-bearing power of the trees. Under these conditions one of the largest trees gave 2.14 pounds of latex, from which 0.69 pound, or 32 per cent, of clean rubber, worth three shillings per pound, was obtained. An attempt to tap the younger trees led to an interesting result, for the latex so obtained was found to contain little or no rubber, but yielded 25 per cent of a putty-like mass, devoid of elasticity, which became hard and brittle. This product would be of no value, and it appears that eight years is about the lowest age at which the tree will yield good rubber—a matter of considerable interest to planters. A curious point is that in places where the roots of a tree have become exposed, it has been found possible to extract large quantities of rubber from them. At present there are several trees of Hevea confusa growing in the gardens, but the rubber yielded is valueless, being yellow and sticky, but it is possible that the quality may improve with the age of the tree. The West African rubber tree, although a comparatively recent introduction into Trinidad, appears to be a most promising plant, growing very freely at the experimental station, where three-year-old trees now average 13½ feet in height and 7 inches in girth. They look as if they would speedily become large trees, and even at present yield latex freely, the rubber from which is of excellent quality and keeps well. That rubber trees will thrive in Trinidad is, therefore, well established, and under fairly similar conditions of climate and soil there is no doubt that they would also flourish in the other islands as well, especially as confirmatory results have been obtained in Jamaica, Dominica and Tobago. The particular tree will have to be selected in view of local conditions, but Castilloa elastica, Hevea brasiliensis, and Funtumia elastica are the three most suitable for general cultivation. The cost of planting can only be approximately estimated, but it is certain that it would not be as much as for cacao, which ranges from £12 to £15 per acre, and in most cases half these amounts would probably suffice. In cultivating rubber trees a very important point is to obtain clean and straight stems, which greatly facilitate the tapping process, and the best method of attaining this is to plant closely at first, afterward thinning out the weaker trees.

Electric Suction.

Lemström's explanation of the blackening of a field of buckwheat blossoms by a thunder-storm is given in an interesting abstract in the English *Electrician*: If we put a capillary tube in a pail of water and connect the pail to the positive terminal of a frictional machine while a pointed conductor connected to the negative pole is held a few inches above the capillary tube, then it is found that when the frictional machine is worked drops of water are formed at the top of the capillary tube, even although it be two feet above the surface of the water. Hence the effect of the electric stress is to suck water up the tube. Now, during a thunder-storm the vegetable juices are sucked up the stalk of the buckwheat through the capillary tubes in which they are contained, and the effect of these juices is apparently to blacken the blossom.

Alternating-Current Lightning Arresters.

Two conditions are essential in a lightning arrester for protection against lightning discharges. It must offer less obstruction to the high-potential discharge in its path to the earth than any other part of the circuit and it must be constructed so as to extinguish the arc that is formed across its air-gaps on a grounded circuit or when simultaneous discharges occur on both sides of an insulated circuit. The first of these conditions determines whether the lightning will discharge through the arrester or some other part of the circuit, and the second determines whether the arrester will extinguish an arc on the circuit or whether it will be destroyed by it. In the construction of all its lightning arresters the General Electric Company, of Schenectady, N. Y., has followed these fundamental principles.



FIGS. 1 AND 2.—TYPES OF ALTERNATING-CURRENT LIGHTNING ARRESTERS.

In this article only the lightning arresters for alternating currents will be described. As both sides of an overhead circuit must be protected with lightning arresters, a simultaneous discharge from each wire may cause a short-circuit from line to line through the ground connections of the arrester. A simple way to prevent this short-circuit is to make the spark-gap in the arrester so long that the generator can not maintain an arc. While this method effectually prevents short-circuiting, it is not effective in protecting electrical apparatus from high-potential discharges, since the resistance of the long air-gap is so great that the lightning may puncture the insulation rather than cross the gap.

These arresters have been designed to operate with short gap spaces. The single-pole arrester for 1,000-volt circuits has two metal cylinders separated by a spark-gap of three-sixty-fourths of an inch. One cylinder is connected to the overhead line and the other cylinder to the ground through a low non-inductive resistance. The action of the arrester is dependent upon the cooling effects of the metal cylinders aided by the reversal of the generator current and the introduction of a non-inductive resistance. The arrester, under normal action, contains a small arc about as large as a pin-head between the cylinders. The single-pole arrester for 2,000-volt circuits has two air-gaps. These arresters are shown in Figs. 1 and 2.

An arrester should be installed on each circuit as it enters the station and at frequent intervals on the overhead lines. In many cases the installation of arresters within 500 feet of each transformer has been found to give effectual protection. Lightning arresters for potentials above 20,000 volts should be divided into two or more sections connected in series, each section consisting of a small number of units well insulated from the wall. Although this arrangement requires a little more space it affords additional security.

A modification of the alternating-current lightning arrester has been designed for individual series arc lamps and for secondary circuits of 3,000 volts and less. This arrester is enclosed in a neat and compact weather-proof iron box, as shown in Fig. 3. No combustible material is used in its construction. In connection with series arc lamps the arrester forms a bi-path protecting the lamp and enabling the discharge to pass along the line to be taken care of by the main line arrester. For the protection of secondary circuits one cylinder is connected to the line and the other to the ground, as in the case of circuits of higher potential. The leads pass through porcelain bushings and may be easily attached to the electrodes, which are mounted on a porcelain base in the interior.

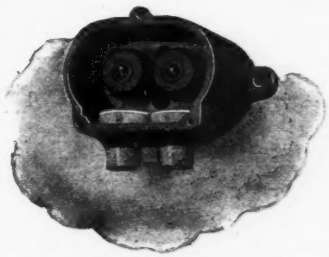


FIG. 3.—LIGHTNING ARRESTER FOR SERIES ARC LAMPS.

There is a considerable difference of opinion as to the advisability of installing reactive coils on alternating-current circuits protected by lightning arresters. Some engineers believe that these coils are essential, while others think that with a good lightning arrester they are unnecessary and serve only to complicate the circuit. This company manufactures two reactive coils for use on alternating-current circuits up to 6,000 volts. These coils are mounted on white Italian marble bases as shown in Fig. 4. They are of sufficient size to prevent heating under

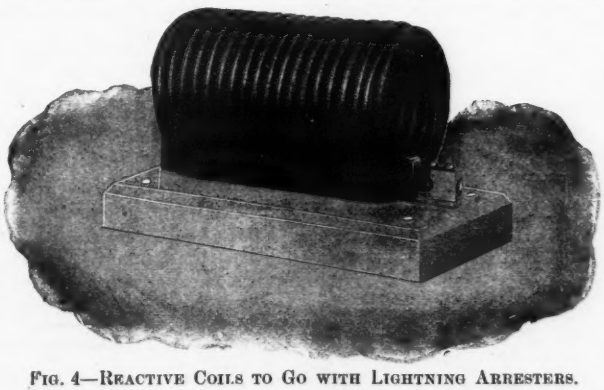


FIG. 4—REACTIVE COILS TO GO WITH LIGHTNING ARRESTERS.

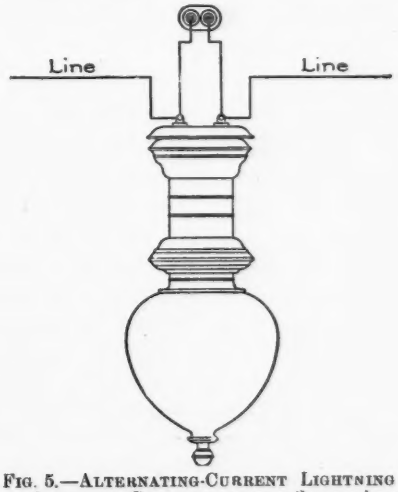
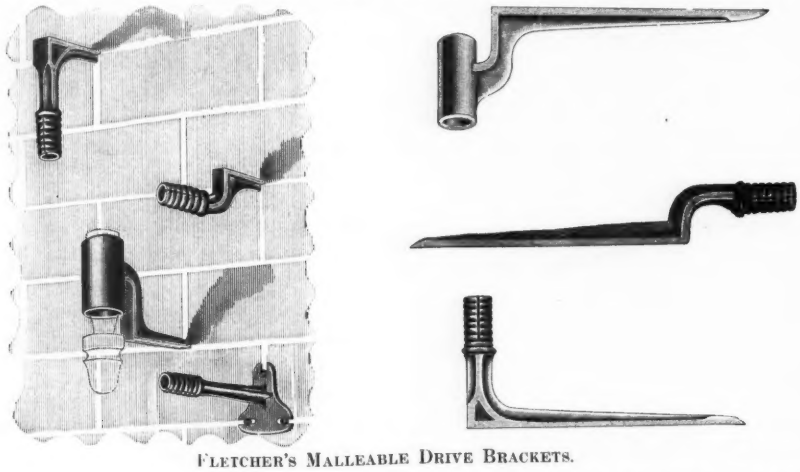


FIG. 5.—ALTERNATING-CURRENT LIGHTNING ARRESTER CONNECTIONS FOR SERIES ARC LAMPS.

continual operation. In Fig. 5 a diagram of the connections of the alternating-current lightning arresters for individual series arc lamps is shown.

Malleable Drive Brackets.

A very useful device has just been placed upon the market by Mr. John R. Fletcher, of the Fletcher Manufacturing Company, Dayton, Ohio. It is known as the Fletcher drive bracket, and is made in several styles to suit the convenience of



FLETCHER'S MALLEABLE DRIVE BRACKETS.

construction people. The use of the drive bracket obviates the necessity of drilling holes in brick walls with cold-chisel, plugging the wall with wood and fastening the ordinary bracket with screws. The manner in which the drive brackets are placed in position requires only that the hard, outside mortar, shall be broken with a cold-chisel, and the drive bracket can then be driven in.

Street Railway Association of the State of New York.

The nineteenth annual meeting of the association will be held at Rochester, on September 10 and 11. Indications point to the most largely attended and interesting convention in the history of the association. A general invitation has been extended to the street railroads of the state, both members and non-members, to send one or more representatives, including, in addition to the officials, the practical men connected with the respective companies. The first day will be given up entirely to the business meeting, followed in the evening by the usual banquet, which will probably he held at Ontario Beach. A portion of the second day will be occupied by a business meeting, followed by an excellent programme of entertainment arranged by Mr. T. J. Nicholl and the local committee.

Upwards of 600 invitations have been sent to supply houses, asking them to send representatives and make exhibits. From the responses received thus far, a large number of supply men will be present. The usual number of brief and concise papers upon street railway topics of practical interest will be read and discussed. In addition to the papers and in accordance with the following resolution: *"Resolved,* That the topic 'How to Increase the Efficiency of Employés,' be separated under different heads, to be suggested by Mr. H. H. Vreeland, and that he allot to the various street railway companies throughout the state the various sub-topics suggested, and that representatives of the respective roads prepare to discuss the same at the next annual meeting" —the following assignment to make 10-minute addresses upon this subject under the following subdivisions has been made by Mr. Vreeland (for the purpose of opening discussion):

"Discipline," E. G. Connette, general manager, Syracuse Rapid Transit Company.

"Benefit of Benefit Associations," Orrin Root, assistant general manager, Metropolitan Street Railway Company, New York.

"The Proper Selection and Training," J. P. E. Clark, general manager, Binghamton Railroad Company.

President G. T. Rogers extends a cordial invitation to all supply men to be present and make an exhibit if possible.

New Electric Generator.

A French scientist, M. S. North, has invented a new power generator which it is claimed will supplant petroleum as a motive power and will make stopping to take on a supply of electricity unnecessary for automobiles. The device consists, it is announced, of an automatic generator of electricity which takes up very little space and makes electricity as the automobile proceeds on its journey. It is stated that the French Government has under consideration the advisability of adopting this new invention for submarine boats.

Views, News and Interviews

A novel and peculiar suggestion is before the Committee on Electricity and Electrical Appliances of the exposition to be held in St. Louis in 1903. It is to construct a building of glass with steel framing. Such a building is claimed to possess many advantages and make possible many novel and curious results due to "atmosphere of captive electricity purely stationary in quality and thus not productive of the violent action of currents with a circuit or earth connection. It is a fact already well known in electro-therapeutical science, though not developed beyond the stage of experiment, owing to the difficulty of establishing the required physical conditions, that simple saturation of the human body with magnetism, produced by the ordinary electric method, exerts upon the subject an influence of singular buoyancy and felicity, which is believed by progressive investigators in this new field to embody possibilities in the treatment of human maladies of the most startling character." Electricians in general will be skeptical of the utility of such a building.

The game of "high wheel" was invented at Albany, in one of the hill resorts, says the New York *Tribune*. To keep the place comfortable several wing fans, driven by electricity, were placed over the tables. One day during the hot spell pinochle and even poker were abandoned. A lawyer suggested having a game with a fan. He pressed the button which turned off the power, and, when the fan had come to rest over the table, made a chalk mark on one of the blades. Then he said," chip in a quarter a corner," and every man put a quarter on the table. The fan was then started and stopped and the man over whom the marked wing had stopped declared the winner. Within a few minutes after the electric game had been suggested every fan in the place was working.

A report of a curious discovery at the X-ray laboratory in Chicago has been given out. It is said that the X-ray apparatus has proved that Mr. Karl Wambold has two healthy hearts. The right heart is said to perform its function as properly as the left heart against which it presses slightly. Both are as free from disease, apparently, as any normal heart.

Mr. Marconi has a motor carriage which is equipped with a folding cylinder on top of the car and devices for the transmission of wireless telegraphic signaling. Motor cars fitted with this device are to be used in forthcoming military manœuvres in Europe.

Current Electrical News

COMMERCIAL NEWS

DOMESTIC AND EXPORT

The new electric railway from LeFayet to Chamonix, France, was opened about August 1. This line shortens the journey from London to Chamonix to 25 hours.

The Mexican director-general of telegraphs and telephones has approved of the construction of a telephone line from Acapoucta to Quimuches in the territory of Tepsic.

The Railways Company General has sold to the Everett-Moore Syndicate the control of the Michigan Traction Link between Battle Creek and Kalamazoo, Mich., for $198,000.

The street railway systems of Salt Lake City, Utah, have been merged in one corporation. The property of the Salt Lake City and of the Rapid Transit Companies was transferred to the Consolidated Railway and Power Company, which has a capital stock of $4,000,000.

The enlargement of the plant of the Virginia Railway and Development Company has been authorized by the directors. This plant is on the James River, and is to be enlarged so as to develop its full capacity of 12,000 horse-power. It is expected that this enlargement will cost about $200,000. The engineers are now at work on the plans.

The Mellon interests, of Pittsburgh, Pa., are preparing to spend $2,000,000 on the construction of their street railway lines, but do not expect to begin immediately. The Allegheny common council has passed their ordinances, and Mr. Mellon states that it is not likely that they can begin the construction of the new line before next spring.

United States Consul Canada, of Veracruz, states that it is reported that three banks have formed a company under the name of Almacenes Generales de Deposito de Mexico y Veracruz, and have entered into a contract with the Mexican Government for the purpose of erecting bonded warehouses in the city of Mexico and at the port of Veracruz.

The Mexican city of Oaxaca will shortly have an electric lighting system. Its population is about 30,000. At the outset, power sufficient to furnish light for 3,000 incandescent lights will be used, but later the plant, according to Mexican advices, will be considerably enlarged. Oaxaca capitalists have united for the purpose of establishing the initial plant.

The general traffic manager, Mr. W. M. Bicknell, of the Miami & Erie Transportation Company states that the work of grading the canal tow path for a new trolley motor road between Cincinnati and Dayton is now about one-fourth completed. It is hoped that the track laying may begin about August 1, and that the new line will be in operation by or soon after the first of the year.

A corporation which is capitalized at $5,000,000 with power to increase its stock to $25,000,000 has secured a charter in Bridgeport, Ct., by a special act of the legislature of that state. The five incorporators whose places will be taken by the real backers of the enterprise are said to be representatives of the Elkins-Whitney Syndicate, of New York. The corporation is known as the International Power Company.

The city council of West Superior, Mich., has passed the ordinance giving the Black River Falls Company a franchise to operate in that city. Mr. W. C. Sargent is interested in the company and has given the city council assurances that it will go ahead and erect poles, string wires and furnish the cities of West Superior and Duluth motive power which will be generated at Black River Falls some 20 miles from West Superior.

The West Oakland railroad yards of the Southern Pacific system, in California, will get power from the Bay Counties Power Company and thus change from steam to electricity. These shops are the second largest of the Southern Pacific system and have long been run by steam. The company had made arrangements with the Standard Electric Company, but owing to the burning of the Standard's plant at Blue Lakes, this company could not fill the contracts in the time desired.

It is stated that the Union Traction Company in conjunction with Pennsylvania railroad interests has purchased the new rapid transit franchises in Philadelphia, Pa., for $1,750,000. It is said that they had agreed to pay $3,500,000 for the franchises provided the franchise for the Broad street service line was decided to be good. This was left to New York lawyers, who decided unfavorably and therefore the price was cut in half. These are the franchises for which John Wanamaker offered the city $2,500,000.

The electric traction system of the city of Mexico, which is at present controlled by British capital, of which the London financial house of Wernher Beit & Company has contributed the largest share, will, it is anticipated, shortly pass into the hands of American capitalists who purpose making considerable extension to the road. The system is operated entirely with American equipment and is regarded by electrical experts as being one of the most perfectly installed traction roads in Latin America.

A representative of the Everett-Moore Syndicate has been in Wheeling, W. Va., with the object of opening negotiations for the purchase of the stock and plant of the Wheeling Traction Company with the view of making it part of that system. An offer to take over all the stock and bonds of the Wheeling Traction Company at a figure nearly 50 per cent in advance of par was named. The value of the Wheeling Traction to the syndicate lies in the fact that it has good connections and franchises extending north to St. Clairsville, Ohio.

Mr. Max Tolz, mechanical engineer for the Great Northern Railroad, announces that plans are practically ready for equipping and building from 75 to 150 miles of the Cascade Division of the road with electric motors. The power will be generated from the water falls of the Skykomish and Tumwater rivers, which are alongside the road. The smoke trouble of the Cascade Tunnel has rendered this necessary, as engineers and firemen have been frequently overcome by the smoke. The Great Northern is also preparing to install electric power in its round houses and shops.

The Costa Rica Electric Light and Tramway Company, which is a British capitalized concern operating three and a half miles of road in San Jose, Costa Rica, is about to be extended for a distance of two miles. Water power is used in working the system but the lowness of water during the dry season necessitates the cars ceasing to run at 5.30 P. M., as the whole available current is then required for lighting purposes. With a view to overcoming the difficulties incurred by the lack of water, it is proposed to erect a plant some distance from San Jose where a more abundant water-power can be derived.

It is said that an agreement has been reached between the Rocky Mountain Telephone Company and the Northwestern Company, whereby the former will build at once from its present eastern terminus at Billings to Miles City, Mont., while the Northwestern Company will build west from its North Dakota terminus to Miles City. This will give the Bell company lines from Boston and New York to Chicago, St. Paul, Minneapolis, Helena, Portland, San Francisco and Los Angeles. It is thought this development means the installation of the Pupin long-distance telephone system owned by the parent Bell company.

Chief Engineer H. W. Cowan, of the Colorado & Southern Railroad, has been investigating the relative cost of operation, maintenance and business of electric passenger lines as compared with steam roads. He is convinced that electric power affords a cheaper method of operation. As evidence of the fact, the steam roads of the New England and Middle states are paralleled by trolley roads, which have succeeded in reducing rates very materially. Mr. C. K. Durbin, who was with Mr. Cowan in making investigations in the east, has gone to Europe to investigate the Ganz alternating-current system. Nothing definite will be done toward making a decision until the report of Mr. Durbin on his observations in Europe has been made.

AUTOMOBILE NOTES

Owing to the failure of the Pan-American authorities to secure the necessary consent for the proposed 100 mile race between Buffalo and Erie, Mr. F. M. Butler, secretary of the Automobile Club of America, announces that its annual sweepstake race and one mile record race will not be run over this course. The governors of the club have, therefore, decided to hold the annual sweepstake race and the one mile record race elsewhere in October, preserving its international character by inviting entries from abroad as originally proposed.

Queen Alexandra, of England, has placed an order with the City and Suburban Electric Carriage Company, of London, for an electric victoria, which she is going to present to the Dowager Empress of Russia. It is a Mark XII Columbia, and is similar in all respects to the carriage now owned by her majesty.

Mr. O. F. Thomas has been appointed receiver for the property of the General Carriage Company. The offices of this company are at 135 Broadway, New York, N. Y. The General Carriage Company was started about two years ago, and was capitalized at $20,000,000. It claimed ownership of a franchise to run stages on any street in New York city, but its plans never fully materialized. Mr. Cyrus Field Judson was its president.

In its next great manœuvres, the German Army will make a thorough series of tests upon different types of military automobiles. This will complete the tests which were commenced two years ago and whose results were excellent. For this purpose the Reichstag has appropriated about $35,000. It is considered that the automobile will be specially useful in modern engagements where the line of battle will be greatly extended, as it will allow the general to remain in rapid communication with the troops. It is proposed, also, to use the automobile for the service of campaign hospitals, for luminous signals, and for the transportation of troops and baggage.

ELECTRICAL SECURITIES

There was much increased animation shown by the market during the week just closed. Large operators are evidently quietly picking up the stocks sold by the West. The market unquestionably shows a revival of confidence by the financial community at large, and reported favorable prospects of special properties and favorable action regarding dividends or other encouraging developments again find ready acceptance. The strike situation is apparently improving somewhat, or at all events is getting no worse. Any important change now would probably be for the better. This is shown as much by the steady advance in the steel stocks as by anything else. That this should tend to strengthen bullish sentiment where it already exists is reasonable.

New York:

ELECTRICAL SECURITIES FOR AUGUST 24.	Highest.	Lowest.	Closing.
Brooklyn R. T...	77⅜	73½	77⅛
Con. Gas.....	227½	221	227½
Gen. Elec.....	265½	259½	265½
Man. El.....	121¾	117	120¾
Met. St. Ry.....	170	165¾	169⅝
Kings Co. Elec...	...	...	197
N.Y. & N.J.Tel.Co.	...	...	175
Telep.,Tel.&Cbl.Co.	...	...	3

There is a revival of interest in Brooklyn Rapid Transit. It is believed that the stock is largely held in strong hands, having been accumulated by individuals who made a study of the company's position and prospects.

It is stated that the shares of the American Telephone and Telegraph Company will be traded in on the New York Stock Exchange beginning September 3.

There has been good buying of Western Union stock recently. Another quarterly dividend of one and one-quarter per cent will be due in about two weeks. There are still rumors of an alliance of the Western Union with the American Telephone and Telegraph Company, but no definite statement in regard to the matter can be obtained from the officials of either company.

Electric Boat was more active during the week just closed than it has been for some time previously. The common advanced to 21½ and the preferred about six points to 51.

Boston, August 24:

	Closing.
Am. Telep. & Tel.....	163
Erie Tel.....	46
New Eng. Tel.....	140
Mass. Elec. pf.....	93
Westing. Mfg. pf.....	70¼
Edison Elec.....	260

The affairs of the Massachusetts Electric Companies are said to be in a very prosperous condition. The roads are being brought to the highest stage of efficiency under progressive and able management and the earnings are said to be unusually large.

Chicago, August 24:

	Closing.
Chicago Edison Light.....	162
Central Union Telephone.....	45
Chicago Telephone.....	273
Un. Trac.....	16¼
Un. Trac. pf.....	59
Metropolitan El.....	92½

A despatch from Chicago says: "The larger interest in Chicago Union Traction are much encouraged by the steady increase in the earnings of the system. Last year, it will be remembered, the business of the company suffered considerably by the new competition of the elevated road running over a portion of its lines, but within the last few months the earnings have begun not only to exceed those of last year, but even those of two years ago. The gross receipts for July were more than 10 per cent, or approximately 966,000 larger than for the same month last year, and about 23,000 larger than for July, 1899. The returns for the current month, as far as reported, indicate that they will show even a larger increase for the month than those of July. There is very little stock afloat, as it appears to have been picked up for some time past by New York purchasers, presumably members of the Whitney-Ryan Elkins-Widener syndicate. The point is made that the company is now making larger gross earnings than two years ago, when it was paying dividends on its preferred stock."

The regular three per cent quarterly dividend of the Chicago Telephone Company has been declared payable October 9. Books will close September 26. Stockholders of record on that date will have the privilege of buying on October 9 at pro rata to present holdings of stock, $1,000,000 of new stock to be issued.

The right to assess franchises is to be made a test case in Chicago, probably upon one of the franchises of the City Railway.

Philadelphia, August 24:

	Closing.
Elec. Co. of Amer.....	7⅝
Philadelphia Elec.....	5⅝
Union Traction.....	29⅜
United G. I. Co.....	115¼
Elec. Stor. Bat. c.....	77
Elec. Stor. Bat. pf.....	78

The statement of the United Gas Improvement Company to the city of Philadelphia of earnings from gas sold in Philadelphia shows gross for the June quarter an increase of $84,630 over same period last year. For the half year the increased was $186,813 over same period last year.

The annual meeting of the Union Traction Company will be held September 18. Books closed August 28 and will reopen September 19.

LEGAL NOTES

TELEPHONE COMPANIES' LIABILITIES — In Griffin *vs.* New England Telephone and Telegraph Company, decided by the Supreme Court of Vermont in September, 1900 (48 Atl., 643), it was held that where the death of plaintiff's intestate was caused by lightning, which came over defendant's wire while deceased was sitting in his library, under the telephone which he had rented of defendant, and there killed him, the questions whether there were known appliances by which the danger from such lightning as killed deceased could be averted, and whether defendant was negligent in failing to supply and use such appliances, were for the jury. It appeared that a telephone pole was struck by lightning about a quarter of a mile from decedent's house, and the current, running along the wire through the telephone, passed through his body, killing him. It was held that the question whether he was guilty of contributory negligence in not knowing that defendant had not adopted and maintained proper appliances to avert the danger, and in sitting where he was when the storm was approaching, was for the jury.

STREET RAILWAY CONNECTIONS—In the recent case of Brown *vs.* Atlantic Railway and Power Company, the Supreme Court of Georgia held that a street-car company which has acquired the lines of street railway of two other companies may, when authorized by its charter and with the consent of the authorities of the city in which the lines of railway are situated, connect the lines acquired from the other companies by laying its tracks upon such portion of a street of the city as may be necessary to make the connection; that a street-car company having authority to lay its tracks along the streets of a city will not be enjoined from laying its tracks along a given street at the instance of one claiming to have an interest in a line of street railway in another street on the ground that the construction of the new line may operate as an abandonment of the line in which he is interested, and that a general power in the charter of a street railway company to construct a line of street railway authorizes the construction of double tracks upon the streets of a city, provided the authorities of such city consent that the streets may be so used.

AUTHORITY OF RAILROAD COMMISSIONER—The Supreme Court of the State of Michigan has recently rendered an important decision regarding the power and authority of the commissioner of railroads in the matter of a separation of the grades at the crossings of electric and steam roads in that state. An application was made by the Jackson and Suburban Traction Company for the approval of a grade crossing of its line with the Michigan Central Railroad on Page avenue in the city of Jackson. The commissioner refused to approve of a crossing at grade and ordered that it be made by means of an overhead bridge. The traction company and the city of Jackson then joined in an application to the Supreme Court for a writ of mandamus requiring the commissioner to set aside the order and allow a crossing at grade, contending that the power and authority to regulate and control its streets was vested by the legislature in the city, through its charter, and that the law under which the commissioner secured his authority to control crossings of this nature was void so far as it refers to crossings that are upon the streets of a city subject to the terms of a city charter. The court refused to issue the writ and upheld the order of the commissioner, taking the position that the police power of the state in cases of this nature is superior to any local authority, and that such power can not be restricted or hampered by the action of a city council or by any provision that may be made in the charter of a city.

VESTED RIGHTS OF RAILWAY COMPANIES—The Michigan Supreme Court has rendered an important decision in the case of the Detroit, Fort Wayne & Belle Isle Railway Company *versus* the commissioner of railroads. In this case an order was issued by the commissioner for safety gates at the Clark avenue crossing of the tracks of the Union Terminal Association in the city of Detroit, and for derailers in the tracks of the street railway company, such gates and derailers to be operated by a tower man, the expense of the construction, operation and maintenance of the appliance to be equally divided between the two companies. It was claimed by the street railway company that inasmuch as its line was built and in operation before the building of a railroad at this point, it had secured a vested right that could not be disturbed by legislative action, and that it could not be required to pay any part of the expense made necessary by conditions created after its line was built and for which it was in no way responsible. The court held that the statute under which the order was issued, and which makes it the duty of the commissioner of railroads to examine the crossings of steam and electric roads now existing, and to order such changes made in the manner of such crossings, or safeguards for the protection of the public thereat, as in his judgment shall appear to be necessary, and to apportion any expense incident thereto between the companies affected as he may deem just and reasonable, was a valid enactment, and that such discretionary powers might properly be vested in the commissioner by the legislature. A number of other orders issued by the department in which the same question is involved have not been enforced, pending the decision in this case, but will now be taken up and forced to a conclusion, and for this reason the decision has beeen awaited with interest. A dissenting opinion was filed by Judge Grant, taking the position that the use of a street by a street railway company is a strictly legitimate use, and that such companies should not be required to pay any part of the expense necessary for the protection of railroad crossings any more than other travelers by vehicle on the public highway.

TELEPHONE AND TELEGRAPH

The Union Telephone Company, of Alma, Mich., has increased its capital stock from $150,000 to $200,000.

The telephone company in Troy, N. Y., will spend about $100,000 in fitting up a building for its occupancy.

The Valley Telephone Company, of Sebuwaing, Mich., is building a line between Port Austin and Point Aux Barques.

The Cresson Telephone Company, of Altoona, Pa., has bought the stock and franchises of the Northern Cambria Telephone Company.

The North Adams & Wilkins Settlement Telephone Company, of North Adams, Mass., is incorporated with the Delaware Valley Telephone Company.

The Farmington Valley Telephone Company of Connecticut, has filed a notice of an increase of stock from $7,000 to $10,500 with the secretary of state.

Mr. Charles Narton and an engineer of the Long-Distance Telephone Company, of Indianapolis, Ind., have completed the survey from Greencastle to Terre Haute.

The Farmers and Traders' Telephone Company, Freemont, Iowa, has taken in about 40 new members and is now extending its line to Ben Buskirks, south of Freemont.

In Port Henry, N. Y., a local telephone company is being organized. It is hoped by the company that they may be able to secure connections with a number of towns in Essex County.

The independent telephone manufacturing companies all report a rushing business, and expect it to continue during the fall and winter. The demand for telephone service increases constantly.

Three telephone companies, of Cleveland, Ohio, announce their intention to extend a welcome and office facilities to the visiting G. A. R. veterans next month. The visitors will, undoubtedly, largely avail themselves of this hospitality.

The people of Lenox, Mass., have passed a special by-law regulating the speed of automobiles to eight miles an hour within the city limits, and 15 miles outside. The penalty for violation of this law is fixed at $100 fine or ten days' imprisonment.

Mr. Sholes, superintendent of telegraph for the Atchison, Topeka & Santa Fe Railway, is experimenting with a telephone system in which the railway wire is used for telegraphing and telephoning at the same time without interference between the messages.

Arrangements for the entrance of the Illinois Telephone and Telegraph Company into Chicago have been made. The company has filed a trust deed under mortgage to secure a bond issue of $5,000,000. Mr. A. G. Wheeler, the president of the company, says that the work of installing the plant will be pushed very vigorously from this time on in order that they may establish telephone service at the earliest possible date. They are endeavoring to complete their plans so as to have 15,000 telephones in operation in the lower part of the city by next spring.

OBITUARY NOTICE

MR. CHARLES NASH, J. P., who was well-known in the English telephone world, has died at the age of 82. He was originally the chairman of the Western Counties Telephone Company. His death will be a great loss to Bristol in the municipal affairs of which he played a prominent part for many years.

ELECTRIC LIGHTING

The people of Lehigh, I. T., are to have an electric light plant.

A municipal electric light plant is to be constructed in Altamont, Ill.

In Marinette, Wis., the people are soon to vote upon the proposition of an electric lighting plant.

The people of Harpersburg, W. Va., are to erect a municipal electric light plant at an expense of $16,000.

Mr. D. O. Bourse has received the contract for building a large power-house for H. Roelof & Son at Roelof Station, Pa.

The municipal lighting plant of St. Joseph, Mich., wil be built by the Fort Wayne Construction Company, of Fort Wayne, Ind.

Mr. Philip F. Jeckell, of Anderson, Ind., has made the plans for a brick and steel power station, which will cost about $8,000.

In Augusta, Ga., Mr. George Stewart Phinizy has applied for permission to build an electric light and gas plant.

Mr. William R. Dougherty is taking estimates for the power-house to be erected in Gibbsborough, N. J., for John Lucas & Company.

In Toledo, Ill., Charles Hanker, village recorder, will receive bids until September 2 for a boiler and other apparatus for an electric lighting plant.

It is reported that the Oshkosh Electric Light Company, of Oshkosh, Wis., will be reorganized and will spend $60,000 to rebuild its plant.

The city of Los Angeles, Cal., will soon submit the bid for the contract for street lighting. It will add about 100 lamps to the 824 now in service.

The Grantsburg Electric Light and Power Company, of Grantsburg, Wis., has received a franchise to build its plant, which it will begin upon at once.

Messrs. C. E. Dupuy and W. J. Dancer have received a 30-years' franchise to furnish the city of Stockbridge, Mass., with electric or gas lights.

The Electric Heat, Light and Power Company has been organized in Vanceburg, Ky. It will erect a plant at once. Mr. G. W. Stamper is president of the company.

A new incorporation to be known as the People's Light and Power Company, of Jeanette, Pa., has been formed and an application has been made for a charter.

In Poughkeepsie, N. Y., bids are being asked for engines and dynamos for the Hudson River state hospital. Mr. G. L. Heins, of Albany, N. Y., is the state architect.

A new electric light and ice manufacturing plant is soon to be constructed in Grand Island, Neb. The company is capitalized at $200,000. Mr. John S. Knott and Mr. G. H. Payne are among those interested.

In Nashville, Tenn., plans are being prepared for a power-house for the electric lighting company by Brown & Brown, 126 North Bruce street. The building is to be built of brick at a cost of $20,000.

The people of Merrillan, Wis., have voted to bond the village for $10,000 to build an electric light plant and a system of waterworks. The same power will be used for both, and the plant will be owned by the village.

The foundation of the new electric lighting station of the Narragansett Electric Lighting Company is nearly completed in Warren, R. I., and work is expected to begin on the building itself soon.

Electric lights are to be installed in Shepherdstown, W. Va. The town council has awarded the contract for the erection of the plant to the Jacob G. Schaff Electric Company, of Chambersburg, Pa.

The contract for the erection of the power-house for the electric light plant in Chatham, N. J., has been awarded to Halsey J. Sturgis, of Madison, N. J. His bid was $2,100. It is for the enlargement of the power-house now used by the water plant.

Machinery has been installed for the use of oil for fuel in the plant of the Citizens' Electric Light Company, at Houston, Tex. They have three 12,000-gallons capacity storage tanks and use about 90 barrels of oil daily.

Mr. Allen, secretary of the International Correspondence Schools, of Scranton, Pa., has applied for a charter for an electric lighting company. The new concern will secure a franchise from the boroughs of Dalton, Clarks and other near-by places.

More than $26,000 a month for light is spent by the city of Mexico. It uses 501 arc lights of 2,000 candle-power, and 383 of 1,200 candle-power, besides a considerable number of smaller incandescent lights for some of the narrow streets and small squares.

The People's Gas Light Company has been formed in California. It is the corporation which is to take over the Central Light and Power Company and the Equitable Gas Light Company. Its capital stock is $3,000,000 divided into 30,000 shares with a par value of $100 each.

The Lancaster County Railway and Light Company, of Lancaster, Pa., has awarded a contract for the erection of a power plant to cost over $300,000. The intention is to furnish power for all the trolley lines in the county and electric lights for the towns and villages.

The Buffalo Structural Steel Company has received the contract for the erection of the framework of the power plant on the old Chester mill site in Lockport, N. Y., of which Charles E. Jackson is the owner. The contract for the placing of two 250-horse-power boilers and one 750-horse-power Corliss engine has been awarded to the Dixon Transfer Company.

In Grand Rapids, Mich., the Fred Macey Company desires bids for one 200-horse-power slow-speed Corliss engine; one 400-horse-power slow-speed Corliss engine; three 250-horse-power water-tube boilers, condensers, piping, compressed air equipment; one 125-volt direct-current, low-speed belted generator; five shop motors, etc. Field & Hinchman, Majestic Building. Detroit, Mich., are the engineers.

The Kansas City Electric Light Company, of Kansas City, Mo., has, as a result of the steel strike, decided to use brick instead of steel for the stacks of its new $750,000 power-house, for which it has just broken ground. There are to be two of these chimneys, each of which is to be 243 feet high. The brick used will come form Germany, and is made by the Alphons Custodis Chimney Construction Company.

The National Electric Light, Heat and Power Company has submitted a bid to light the streets of Orange, N. J. It is a question whether or not Mr. Thomas A. Edison is at its head. Mr. William E. Gilmore, the president, signed the bid. Mr. Gilmore is the manager of the Edison Phonograph Works and intimately associated with Mr. Edison in many business enterprises. It is said that the company has obtained options on property on which an electric lighting plant will be erected in time to take over the street lighting business if the contract is awarded to it. Both Mr. Edison and Mr. Gilmore are away at present, which makes it impossible to secure any further information.

ELECTRIC RAILWAYS

Construction work on the Central Railway, of Peoria, Ill., will soon begin.

A large force of men is at work fencing in the tracks of the Seattle & Tacoma electric road of Washington.

Good progress is being made upon the construction of the trolley extension of the Media, Glen Riddle & Rockdale line from Media, Pa.

Judge Roraback has granted a petition to the Connecticut Railway and Lighting Company for a trolley road from Ansonia to Seymour, Ct.

The Allen trolley line, of New York, is being rushed through, and the subway at the Erie Railroad and Sowles's Crossing is nearly completed.

The Mechanicsburg council of Mechanicsburg, Pa., has been asked by the Star Traction Company for permission to lay tracks through the town.

The New Hope & Doylestown Trolley Company, of New Jersey, has been granted the right of way by the commissioners of Doylestown township.

News comes from Maryland that the building of an electric railway between Oakland, Deer Park and Mountain Lake Park will soon be commenced.

In Parkersburg, W. Va., a company with $500,000 has been incorporated to construct and operate an electric line in Parkersburg and the surrounding country.

Capitalists of Independence, Mo., are forming a company to build a street railway system in Independence and later a line from Independence to Kansas City.

A project is being considered to locate the power plant in St. John's instead of Maple Rapids, Mich., by selling the electric light plant to the railroad company.

An ordinance permitting the Monongahela Traction Company to lay tracks on a number of the streets of Wilkinsburg, Pa., will probably be passed by the city council.

A new engine is to be installed at the power-house of the Grand Rapids Railway Company, of Grand Rapids, Mich. It will be a Filer-Stowell engine of 500 horse-power.

The New Paltz & Poughkeepsie Traction Company's road, according to President Case, will be extended from New Paltz to Rifton, N. Y., if the rights of way can be procured.

The Alton & East Alton Electric Railway Company, of Illinois, will begin the construction of the railroad from Alton to East Alton as soon as the franchise and rights of way can be obtained.

The Columbia-Montour Electric Railroad has completed its line between Lime Ridge and Bloomsburg, Pa. Good progress has been made in the construction work upon the Berwick-Lime Ridge division.

The work on the line of the Citizens' Traction Company, Pa., from Franklin to Smithman Park is being pushed rapidly. D. J. Geary, of the company, is confident that cars will be running by August 15.

The Worcester & Charlton Street Railway Company, of Worcester, Mass., has started to build its tracks. The new company has about 300 men at work, and it will not be long before the line is completed.

It is reported that a charter will probably be granted to run electric cars from Sugar Notch to Warrior Run, Pa. A preliminary survey has already been made and a final survey will be made within the next week.

A new electric line to run from Saginaw, Mich., to St. Johns is being agitated. The directors of the Lansing & St. Johns electric line are said to be concerned in the plan.

The Buckeye Traction Company, of Crawford County, Ohio, has received permission from the county commissioners to construct an electric railway from Bucyrus, Ohio, to Huron County.

The Mohawk River Traction Company has been granted a franchise by the Board of Trustees of Fort Plains, N. Y., to construct an electric railway through the streets of Fort Plain.

The Monroe County Electric Belt Line Company, of New York, has filed articles of incorporation. It is capitalized at $250,000, and will be 20 miles long. Percy McPhail and George W. Aldridge are among the directors.

Two hundred men are engaged in work upon the grade of the Western Ohio Electric Line between Findlay and Lima. The line will be established between Lima and Bluffton. Nearly all the rights of way have been secured.

Mr. Samuel Hill, of St. Paul, Minn., has authorized the statement that if the right of way to construct an electric line between St. Paul and Minneapolis is granted, that the road would be in running order by January 1, 1903.

A franchise has been granted by the county commissioners to Daniel H. Buell to build an electric road from Marietta to St. Mary's, Ohio. By the terms of the franchise the road must be completed by December 31, 1902.

A company has been organized in Union City, Ind., to build an interurban line from Richmond to Portland, *via* Union City. Several New York men are among the incorporators. C. S. Pierce is its president. The capital stock is $50,000.

By the incorporating to-day of the Mohawk Valley Traction Company the towns of Herkimer and Little Falls, N. Y., will be connected by a trolley road. The capital stock is $80,000, and the directors are Timothy Darcy, J. Judson Gilbert and others.

Good progress is being made in the preliminary survey of the Batavia, Medina, Lyndonville & Lake Ontario trolley line of New York. The right of way for the entire distance has been secured, and it is probable that there will be little delay in securing a franchise.

Allan W. Page has petitioned Judge Gager, of the Superior Court, for permission to construct a trolley line from Waterbury to Cheshire, Ct. Mr. Page is counsel for the Cheshire Street Railway Company, whose franchise is owned by the Connecticut Railway and Lighting Company.

The people of Noble Township, Ind., have voted to appropriate $50,000 to aid the Wabash & Rochester Electric Railway, the company which has been organized to construct the line joining Wabash and Rochester. The contractors are ready to undertake the construction of the road at once.

Opposition to four prospective trolley lines, which will parallel the lines of the New York, New Haven & Hartford Railroad in Connecticut, has been withdrawn. These trolley roads will extend from Hartford to Springfield, from Derby to New Haven, from Waterbury to Meriden, and from Meriden to New Haven.

The work upon the electric road from Greenwood to Shelbyville, Ind., is to begin at once. It is planned to have the road in operation by next spring. It will be 20 miles long, and it is estimated that it will cost about $350,000. Mr. J. T. Polk is the president of the company which will build the road.

The consent of the State Railway Commissioners for the Troy & Pittsfield Electric Railway Company of New York and Massachusetts has been filed with the Secretary of New York State. This consent allows the company to build a railroad from Troy through Rensselaer and Bath to the state line.

Work has been progressing rapidly upon the Perth Amboy & Metuchen trolley line of Perth Amboy, N. J., but it has been stopped temporarily owing to legal complications. Indications are that, providing the legal difficulties are overcome, the route between Perth Amboy and Metuchen will be running by fall.

The construction of the new Lancaster & York Furnace trolley road, of Pennsylvania, has been begun, and cars will be running before winter. In a short time the building of the Lancaster & York Furnace road will be started. The building of the Susquehanna River is contemplated to connect with a line that is being built to York.

The Waterloo-Denver Electric Railway, of Iowa, has been assured by the signing of a contract by L. S. and J. F. Cass. Samuel Kern, of Charles City, will soon have 100 teams at work upon the grading. The construction of the road will be of the very best and most substantial character; $190,000 will be spent for construction and equipment.

News comes that the steel strike may delay the completion of the Ridge Road trolley line of Lockport, Pa. The steel rails, which were to have been delivered by July 1, may not be delivered before next April. The work of grading, as well as the setting of the poles and stringing of the wires, however, may all be done before that time.

The Parkersburg & Marietta Electric Railway Company has advertised for bids for grading, masonry and trestles for the new electric line between Parkersburg, W. Va., and Marietta, Ohio. There will be 60,000 cubic yards of excavating, 2,600 lineal feet of filling, 332,000 feet of lumber used in trestles and 500 cubic yards of masonry. J. Madison Jackson, of Parkersburg, is chief engineer.

A change has taken place in those who are interested in the Detroit, Ann Arbor & Adrain Railway Company, which has secured most of the franchises from Ann Arbor to Adrian. Mr. William B. Hatch and Mr. John C. Donnelly, of Detroit, were the ones who secured the franchise. They have now assigned them to the Detroit-Ann Arbor Railway Company, of which Mr. Michael Brennan, of Detroit, is the president.

Mr. J. T. Blackwell and Mr. G. R. Webb, representatives of the Baltimore syndicate which recently purchased the San Francisco & San Mateo Electric Railroad, of San Francisco, Cal., are in the West with the object of closing their options on the Sutter Street Line and its adjunct the Sutro Electric Road. The option is tantamount to a contract on the part of the Baltimore people to take the Sutter and Sutro roads for $1,800,000.

At a recent meeting of the directors and stockholders of the North Hudson County Railway Company for the ratification of the trolley merger of the Jersey City, Hoboken and Paterson street railways, the necessary resolutions for the merger were passed and duly signed. Another meeting was held on August 15, when the stockholders were called upon for the payment of the interest and principal on the $1,000,000 worth of five per cent bonds issued by the Bergen Turnpike Company for the building of the line between Hoboken and Hackensack.

A two-mile trolley line between Bangor and East Bangor, N. J., will be built by the Trenton Traction Company.

A surveying party is at work near Port Byron, N. Y., surveying the proposed trolley road from Rochester to Syracuse.

Surveyors have begun setting stakes in Benton Harbor, Mich., for the new road of the West Michigan Traction Company.

The village board of Nelliston, N. Y., will hold a meeting to consider the application for a franchise to the Mohawk River Traction Company.

The Pomeroy-Mandelbaum Syndicate is making plans for two electric railroads from Columbus to Cincinnati, Ohio, and a third toward Wheeling.

Mr. P. L. Spooner, of Madison, Wis., has filed with the city clerk of Janesville, Wis., an application for a franchise for an electric street railway in Janesville.

A new street railway power plant is to be constructed in Lemont, Ill. The excavation for the foundations is already begun and a large force of men is at work.

The special committee of Little Rock, Ark., is considering the granting of a franchise to M. D. L. Cook and W. C. Faucette for a line of street railway in Little Rock.

The city council of Bessemer, Ala., has granted a franchise to the Steel Cities Railway Company, giving it the right of way to enter the city through certain streets.

A new trolley line to connect Providence and Worcester, Mass., is being constructed. Work has been started upon the Uxbridge and Blackstone Street Railway at Uxbridge, Mass.

Hiram B. Rhymer has received general charge of the proposed new electric railway which is to be built between Elmira and Wellsburg, connecting with Tonawanda and other points.

Good progress is being made upon the construction of the electric line between Edwardsville and Collinsville, Ill. The work is being done under the supervision of Contractor Bray.

The Cleveland Electric Railway Company, of Cleveland, Ohio, is having an addition to its power plant built. Andrew Dow & Son have the contract. The work will cost upwards of $50,000.

Those interested in the Windsor Locks & Rainbow Street Railway Company, of Windsor Locks, Ct., have effected an organization. Henry A. Huntington, of Windsor, Ct., is president.

Information has been received that the actual work of construction on the Chillicothe & Hillsboro Traction Company's line, of Hillsboro, Ohio, will be started by the Ohio Trust Company.

Bonds for $500,000 will be issued by the Salt Lake City Railroad Company, of Utah. The money will be used for the purpose of improving the street railway system and also to pay off its indebtedness.

Preliminary surveys for the extension of the Manistee, Filer City & East Lake Electric Railway, of Michigan, from Orchard Beach to Bear Lake have just been completed. G. A. Hart is president of the company.

Cincinnati capitalists are formulating plans for the construction of an interurban line between Stevens Point and Grand Rapids, Mich. Mr. D. O. Brothers, of Grand Rapids, Mich., is one of those interested in the new venture.

Rights of way, franchises and traction material for the Toledo-Bryan Air Line Railway, of Toledo, Ohio, have been secured. The contracts will be let about August 10. The road will be operated by electricity and will be 57 miles long.

J. L. Blackwell & Company, of Baltimore, Md., have secured the contract for building the Philadelphia & Paoli, West Chester & Southern, and the Coatesville & Downington trolley lines. Mr. Albert B. Kelley is president of the company which has chartered these roads.

The Schenectady Railway Company, of Schenectady, N. Y., has applied for a franchise from Schenectady to the Rexfords Flats Ridge along the highway from the city limits to the aqueduct in the town of Niskayuna.

The Durham Traction Company, of Raleigh, N. C., has accepted the new power plant of the company. The traction company will put in the eight miles of street railway as agreed with the city officials some time ago.

The construction of a street railway system in Tyrone, Pa., has been begun. It will be built to Bellwood and will there connect with the Logan Valley line, which commences at Altoona. The American Railways Company, of Philadelphia, will lease the line.

The president and general manager of the Rapid Railway Company, Mr. G. R. Schrughan, has filed an application for an electric road to parallel the Cincinnati, Lebanon & Northern Railroad. This company was recently incorporated in Columbus, Ohio.

The Ringing Rocks Traction Company, of Pottstown, Pa., has received a charter to build a trolley line from the northern limits of Pottstown to connect with the Ringing Rocks road at Boyertown. The capital stock is $54,000. Cyrus Q. Guldin, of Reading, Pa., is president.

At the meeting of the directors of the Nashville Railway, of Nashville, Tenn., and the Cumberland Electric Light and Power Company, Mr. Percy Warner was elected president of both companies. Important improvements and extensions will be carried out and new cars will be ordered at once.

The Perkiomen Valley Trolley Company has received a charter to build 30 miles of road beginning at Collegeville, Pa., and meeting the Allentown & Emaus Street Railway Company at Schwartz's Corners, Lehigh County. Its capital is $180,000. Mr. Henry Trexler, of Allentown, Pa., is its president.

Land has been purchased by the Fonda, Johnstown & Gloversville Railway Company, of Johnstown, Pa., for the erection of a power station for the operation of its electric lines. The station will be modern in every detail and will be built of brick. The total cost will be in the neighborhood of $3,000. It will have a capacity of 3,000 horse-power.

The Interstate trolley line which is being built between Danbury, Ct., and Goldens Bridge, N. Y., will be opened for traffic not later than December 1. The delays due to the excessive prices which owners put upon land desired for rights of way have been practically overcome and the construction force is being largely increased. The company has issued $300,000 stock and $200,000 bonds which has not been disposed of.

Judge Gager, of the Superior Court of Connecticut, has issued an order that public necessity and convenience require the construction of an electric street railway system from Waterbury through Prospect and Cheshire to Mount Carmel, where connection can be made with the New Haven trolley system. This order is granted to the Connecticut Railway and Lighting Company. It is the intention of this company to link Waterbury and New Haven by trolley as soon as possible.

PERSONAL MENTION

MR. GEORGE D. YOUMANS has been appointed general attorney for the Brooklyn Rapid Transit Company.

GIOVANNI ASSUNNA, chief engineer of the firm of Siemens & Halske, has been called to a full professorship of electrical engineering in the Technical Institute at Munich.

MR. C. T. YERKES has gone to Budapest, Hungary, to investigate the Ganz electric system, with a view, it is said, of purchasing the system for use in London and the United States.

MR. R. C. PORTER has been appointed lecturer of mechanical engineering at Birmingham University, England. He is at present lecturer in engineering at the government school at Cairo.

MR. ALFRED SCHWARTZ, of the Southwestern Polytechnic, Chelsea, England, is to be elected professor of physics and electrical engineering in the Manchester Municipal School of Technology.

MR. J. ROBERTS, manager of the car factory of the Melbourne Traction Company, of Australia, is now in this country seeking the latest American ideas in the construction of trolley cars.

MR. H. H. VREELAND, president of the Metropolitan Street Railway Company, gave a clambake to his associate officials Saturday of last week. This annual occasion was greatly enjoyed by all present.

PROFESSOR ELIJI AOYAGI, of the University of Kyoto, Japan, has arrived in the United States from Germany. He will visit a number of our most important electric plants prior to sailing for Japan September 11.

AGOSTINO RIBOLDI, Bishop of Pavia, has had the Cardinal's hat conferred upon him. He is well known for his work in physics and especially electricity. Several other ecclesiastics interested in electrical subjects have recently been raised to the Episcopal throne.

MR. H. V. CROLL, who has been manager of the Spokane, Wash., branch office of the Edward P. Allis Company, has been appointed manager of the branch office to be established at 414 Dooly Block, Salt Lake City, for the Allis-Chalmers Company, with the territory of Utah, Nevada, Montana and Southern Idaho, under the direction of that office.

MR. C. F. FERNANDEZ, Mexico City, Mexico, controls a number of extensive water powers in the vicinity of Mexico which he has for sale. These powers he reports as being particularly well adapted for use with electrical installations, and parties desiring to take up such matters in that country would do well to write Mr. Fernandez at once.

MR. J. D. CORMACK, B. S. C., of Glasgow, has been appointed to the chair of mechanical engineering in the University College, London. This chair was made vacant by the resignation of Professor Hudson Beare, on his appointment as regius-professor at Edinburgh. Mr. Edgar Walford Marchant, D. S. C., has been appointed to the lectureship in electrotechniques in the same college which was vacated by Mr. Alfred Hay's appointment to a professorship at Coopers Hill.

MR. CHARLES LE BLANC, a well-known electrical engineer and contractor, of Paris, is at present in this country. He has received the position of chief engineer of the Compagnie Generale de Traction de Paris, one of the three large syndicates in France which makes a business of equipping and operating electric railways. Mr. Le Blanc was formerly one of the engineers attached to the Sprague Electric Railway and Motor Company. He is at present in the west, but expects to be in New York soon.

INDUSTRIAL ITEMS

THE J. G. BRILL COMPANY, of Philadelphia, Pa., has received the contracts for the rolling stock of the San Bernardino Traction Company.

ALFRED B. OX & COMPANY, of Philadelphia, has secured a contract for the shipment of a 45-ton electric train and transfer table to Kobe, Japan.

THE ELECTRIC APPLIANCE COMPANY, Chicago, have just issued a "Complimentary Meter Book." This book is a small edition of the regular F. & H. meter book, and is being sent free to the trade.

BAILEY, WALKER & COMPANY, of Buenos Aires, Argentine Republic, which deals largely in electrical machinery, has placed an order for generators with the Sprague Electric Company, of New York.

THE ST. LOUIS CAR COMPANY, of St. Louis, Mo., is about to begin the shipment on a contract for 250 cars which was recently secured from one of the principal electric traction systems in Buenos Aires, S. A.

MR. H. W. FLAITE, 202 West Eighth street, Austin, Tex., is in the market for 500 or more five-inch top 25 foot cedar poles. No. 14 B. & S. gage galvanized telephone wire for 50 miles and over, No. 14 B. & S. copper wire for 50 miles and over.

THE MONARCH MANUFACTURING COMPANY, of Waterbury, Ct., has an exhibit of its engine-stop system at the Pan-American Exposition. This is located in the power court in Machinery Hall and Transportation Building. All users of power will find this exhibit of interest.

SANDERSON & PORTER, of New York, are preparing plans for a new power plant for the Rockingham County Light and Power Company. It is to be built near Portsmouth, N. H. The contracts will soon be let. The same company is rebuilding the lines and power plant of the Galveston City Railway Company, of Galveston, Tex., which was destroyed by the storm.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, of Boston, Mass., reports that its business in incandescent lamp manipulators has increased 1,000 per cent over that of last year. The orders for its Morse automatic cord lamp adjuster, tax its present capacity to such an extent that it has decided to move its factory to larger quarters at Quincy, Mass., where it will be able to turn out 1,000 adjusters a day.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY'S page announcement in the ELECTRICAL REVIEW, giving a diagram of circuits and showing the application of power supplied by Westinghouse generators at Niagara Falls, is a particularly graphic presentation of the electrical work this company's machinery accomplishes at the Falls. The showing is very interesting, and has attracted a great deal of attention.

THE CENTRAL ELECTRIC COMPANY, of Chicago, claim the Columbia high-volt lamps are unexcelled, and solicit a trial order to convince the purchaser. The Columbia 110-volt lamps have proven a success for the past 12 years, and from the outlook the company's 220-volt lamps will enjoy the same experience. The Central Electric Company carry a large stock of lamps in all voltages and candle-powers, also street railway lamps.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., in view of the large number of their students who will visit the Pan-American Exposition, have established an information bureau at their Buffalo office and arrangements have been made by which accommodations may be secured during the course of the exposition. The bureau is conducted free of charge and all correspondence intended for it should be addressed to the Correspondence Schools, Ellicott Square Building, Buffalo, N. Y. Visitors to the exposition, whether they be students of the schools or not, are requested to call at the Buffalo office.

THE SPRAGUE ELECTRIC COMPANY is receiving many orders for its apparatus from all parts of the country and abroad. Among recent orders are the following: Ninety-kilowatt split-pole generator shipped to Bailey, Walker & Company, Buenos Aires, S. A.; 125-kilowatt split-pole generator, Steelton Light, Heat and Power Company, Steelton, Pa.; 37½-kilowatt split-pole generator, Ft. Wadsworth, Staten Island, N. Y.; 37½-kilowatt engine-type generator, Ft. Hancock, N. J.; 80-horse-power motor, American Linseed Company, Staten Island, N. Y.; 100-kilowatt engine-type split-pole generator, Geuder & Paeschke Manufacturing Company, Milwaukee, Wis.; 50-kilowatt generator and 15-horse-power motor, Roe & Conover, Newark, N. J.; 85-horse-power motor, John Stephenson Company, Elizabeth, N. J.; 75-kilowatt split-pole generator, Chase Rolling Mill Company, Waterbury, Ct.; 75-kilowatt split-pole generator, Fred Miller Brewing Company, Milwaukee, Wis.; 100-kilowatt 550-volt split-pole belted-type generator, Plymouth Mills, Plymouth, Mass., 100-kilowatt, belted-type, split-pole generator, C. S. Ashley, Toledo, Ohio; 100-kilowatt 550-volt belted-type split-pole generator, and various motors up to 50 horsepower, T. C. Kellar, Chicago, Ill.; a quantity of motors for the mines and refining plant of the Arlington Copper Company, Arlington, N. J.; 100 horse power motor, American Locomotive Company, Cooke Works, Paterson, N. J.; 60-kilowatt split-pole generator, Fahys Watch Case Company, Sag Harbor, L. I., two 25-kilowatt engine-type split-pole generators for Madison Square Garden, New York, and 100-kilowatt split-pole engine-type generator, Leland Hotel, Chicago, Ill.

BEAUTIFUL ELECTRICAL EFFECT—Mr. S. F. Gray, a local electrician, has just completed what is probably the most beautiful electrical display ever seen in a church in the city. It is the illumination of the statue of Our Lady of Lourdes at the Cathedral. As is well-known, especially among Catholics, Our Lady of Lourdes was an apparition which appeared before the child, Bernardette Soubirons, about February, 1858, on a rock at Lourdes. Since then Lourdes has become famous the world over for a fountain the water of which is said to possess most wonderful healing qualities, and which spring was revealed after the child had dug into the sand at her feet at the command of the apparition. Two magnificent churches have since been built near the fountain, which is visited by many thousands annually to receive the benefit of the water. Many miraculous cures are attributed to the properties of the water. The apparition appeared to the child on 18 different occasions, and a statue of Our Lady of Lourdes stands on the left side of the alter at the Cathedral. The statue is of Italian marble. On its head is a magnificently designed brass crown studded with tiny incandescent bulbs. The roses about the feet of the apparition, so the story of Bernardette goes, grew out of the rocks in a day to convince the Bishop of Lourdes of the truth of the child's statement. These roses on the statue are made of Austrian porcelain, while the leaves are of brass and remarkably natural in appearance. Inside each rose is a small bulb, the soft rays of which contrast most beautifully with the brilliant illumination of the circle about the head of the statue upon which is inscribed the words: "I am the Immaculate Conception." The lettering is of gilt and lends additional splendor to the brilliancy of the lights. Each group of lights about the statue can be used separately. The display was designed and executed by Mr. I. P. Frink, New York.—*Baltimore American.*

NEW INCORPORATIONS

WEISSPORT, PA.—Kemmerer Electric Light Shifter. $35,000.

CAMDEN, N. J.—The National Roll Street Car Company. $600,000.

PEORIA, ILL.—The Central Electric Company. Capital stock increased from $5,000 to $25,000.

NATCHEZ, MISS.—The Natchez Electric Street Railway Company. $50,000. Mr. E. H. Ratcliff is president.

NEW YORK, N. Y.—Norden-Bittner Electrical Company. $100,000. Directors: John Bittner, Mortimer Norden and others.

GRUNDY COUNTY, IOWA—Grundy County Mutual Telephone Company. $10,000. Incorporators: Fred J. Frost, E. H. Dodd and others.

SCHENECTADY, N. Y.—Electric Exchange Telephone Company. $10,000. Directors: Charles Palmer, G. M. Bostwick and others.

COHOES, N. Y.—The Cohoes & Waterford Home Telephone Company. $200,000. Directors: S. B. Rawson, I. H. Griswold and others.

NEW YORK, N. Y.—The Telapost Company to construct electric plants. $100,000. Directors: H. S. Sellers, N. S. McKain and others.

GREENWICH, N. Y.—The Consolidated Electric Company, of Greenwich, Washington County. Capital stock increased from $50,000 to $75,000.

NIAGARA FALLS, N. Y.—The Niagara Falls Home Telephone Company, Limited. $40,000. Incorporators: Dr. W. R. Campbell, M. B. Butler and others.

TOLEDO, OHIO—The Toledo, Columbus, Springfield & Cincinnati Railway Company. $100,000. Incorporators: Ellis Bartholomew, William P. Heston and others.

UNION CITY, IND.—The Richmond, Union City & Interurban Street Railway Company. $50,000. Directors: Charles W. Foster, Frank W. Hatch and others.

NEW YORK, N. Y.—P. I. Fagins Electrical Construction Company. $5,000. Directors: Isidor Fagins, of New York; George Cook, of Matteawan, N. J., and others.

JERSEY CITY, N. J.—Nathans Electrical Manufacturing Company. $125,000. To manufacture electrical machinery. Incorporators: Thomas A. Nathans, Frank L. Zabriskie and others.

ALBANY, N. Y.—The Hudson Valley Electric Railway Company. $2,600,000. A consolidation of the electric railway systems from Troy to Lake George. Addison B. Colvin is its president.

OTTAWA, CANADA—Illinois River Railway Company. $150,000. To operate an electric railway in La Salle and adjoining counties. Incorporators: Lewis W. Hess, Jacob I. Warner and others.

SCHENECTADY, N. Y.—The Electric Exchange Telephone Company. $10,000. To operate a telephone exchange in Schenectady and surrounding villages. Directors: Charles F. Veder, Charles E. Palmer and others.

CHARLESTON, W. VA.—The Charleston & Kanawha Valley Power and Railway Company. $500,000. To build electric lines to St. Albans and Montgomery. Incorporators: Thomas J. Carmack, Howard T. Goodwin and others.

PHILADELPHIA, PA.—The Washington, Leonardtown & Point Lookout Railway. $1,000,000. To construct an electric railway from Washington, D. C., to Point Lookout. Ex-Attorney-General White, of Delaware, is its president.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED AUGUST 20, 1901.

680,693 Printing telegraph; J. Burry, Fort Lee, N. J.

680,695 Transmitter for educational purposes; C. S. Comins, Quincy, Mass.

680,704 Electric-traction road; Leon Dion, Boston, Mass.—An unexposed feeder, an exposed conductor, and a member adapted to be moved by magnetic attraction to connect said feeder and exposed conductor, said member comprising small free spherical magnetic bodies collectively adapted to act as the connector, but individually incapable of so acting.

680,792 Alternating-current induction motor; B. G. Lamme, Pittsburgh, Pa.

680,793 Dynamo-electric generator; B. G. Lamme, Pittsburgh, Pa.—An alternating-current dynamo-electric generator, having an armature provided with a plurality of independent closed coil-windings uniformly distributed around a single core and connected in parallel to the distributing circuit or circuits.

680,795 Strap-coil for electrical machines; J. P. Mallett, Pittsburgh, Pa.

680,797 Electro-magnetic motor or reciprocating engine; R. D. Mershon, New York, N. Y.—An electric engine for operating drills or similar devices, comprising means for producing a longitudinally-progressive magnetic field, a plunger actuated by said field and serving to reverse it, and electromagnetic means for effecting a partial rotation of said plunger.

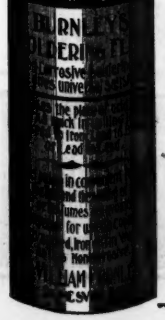
680,798 Mechanism for generating variable electro-motive force; J. E. Miller, Edgewood Park, Pa.—Means for producing a variable electro-motive force, comprising an electric motor driven from an approximately constant-potential circuit, a generator mechanically connected to and driven by said motor, and means for increasing the field-magnet strength of the generator and decreasing that of the motor simultaneously, and vice versa.

680,804 Electrically-propelled vehicle; F. J. Newman, Chicago, Ill.

680,808 Rheostat; T. S. Perkins; Idlewood, Pa.—Comprises a helical, flattened coil of wire disposed in spiral form, and a spirally-disposed strip of insulating material interposed between adjacent convolutions of the wire helix.

680,809 System of electric lighting on constant-current circuits; H. N. Potter, Halensee, Germany—Consists

(Continued on page 33.)



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PATENTS.

(*Continued from page 31.*)

of a multi-glower-lamp, a pilot-lamp in a normally closed shunt thereto, adapted to become luminous when the multi-glower lamp is out of order.

680,834 House-wiring; F. Bathurst, Southfields, England.

680,848 Zinc electrode for electric batteries; W. Erny, Halle-on-the-Saale, Germany—A porous zinc electrode for electric batteries, consisting of a zinc cylinder, a spongy zinc-amalgam filling applied to the side of said cylinder in mass, and a perforating retaining medium of zinc holding the amalgam to the zinc cylinder.

680,879 Telephone-exchange apparatus; F. R. McBerty, Evanston, Ill.

680,880 Connection register for telephone exchanges; F. R. McBerty, Evanston, Ill.

680,881 Selective calling-key for party-lines; F. R. McBerty, Evanston, Ill.

980,890 Connection-counter for telephone exchanges; C. E. Scribner, Chicago, Ill.

680,922 Outlet-box; Henry Ill, Newark, N. J.

680,933 Incandescent lamp-socket; N. Marshall, Newton, Mass.

680,968 L. W. Downes, Providence, R. I.

680,981 Electric switch; M. H. Johnson, Utica, N. Y.—Consists of the blade and a contact-post, having the U-shaped spring portion with a main contact-face, and the projecting arm portion with the supplementary contact-face.

680,982 Burglar-proof device for safes; A. T. Metcalf, Battle Creek, Mich.

680,988 Magnetic speed-indicator; S. B. Storer, Syracuse, N. Y.—Comprises a field-magnet, a movable armature and a movable low-resistance part, both mounted to be cut by the same lines of force of the common field, one of the movable elements being revoluble and acting to drag along the other element, which is oscillatory, and a mechanical biasing device for the oscillatory element.

681,002 Motor meter for alternating currents; A. Peloux, Geneva, Switzerland.

681,030 Railway signaling; F. McBrien, Newark, N. J.

681,039 Electric railway; W. Chapman, Washington, D. C.—Comprises pick-up and feeder circuits, traveling and stationary contacts, and automatic switches for completing the feeder circuit through said contacts, a motor-generator taking current from the feeder circuit and supplying current of lower tension directly to the pick-up circuit.

681,057 Delivery switch; C. M. Johnson, New York, N. Y.

681,099 Method by which several telegraphic messages can be transmitted at the same time through one conductor or by wireless telegraphy; A. Bull, Cologne, Germany.

681,107 Electric furnace; A. H. Cowles, Cleveland, Ohio—An electric furnace having a wall permeable to vapors and gases, and a condensing-chamber outside of said permeable wall.

681,112 Carbon break for electric switches; H. D'Olier, Jr., Philadelphia, Pa.

681,133 Starting apparatus for electric motors; T. S. Perkins, Idlewood, Pa.

681,167 Electrical controller attachment; G. L. Fairbrother, Thompsonville, Ct.

REISSUE.

11,929 Supervisory signal for telephone-switchboards; C. E. Scribner, Chicago, Ill.

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